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Aims and Trends in Teaching of Biology*

EDWARD C. SCHNEIDER
Professor of Biology, Wesleyan University
Middletown, Connecticut

The privilege which has been accorded me of being the first speaker in this symposium which is to consider the value of the contributions of the fundamental sciences to the premedical student, permits me, I take it, to digress in my introductory remarks from the subject assigned to me by your secretary. There are certain trends in the educational set-up of our country and among entrance committees of the medical schools which seem to be reshaping premedical education. There is a growing and determined desire that our institutions of learning prepare a curriculum that will more surely provide technical knowledge in preparation for life's activities. No small number of people believe that present-day education is far from being sufficient to fit the young for practical service, and they insist that the object of the college and the university is to prepare the student for life, rather than to make a scholar of him.

From another direction a disturbing influence has arisen. The present century has seen the introduction of methods of psychological research which have profoundly influenced our systems of education. While much of this research is good, unfortunately it has bred a group of zealots, with scant preparation, whose chief efforts seem to be devoted to criticism of our colleges and universities and to an attempt to carry over into them the methods and ideals of the secondary schools. They insist that both the substance and method of teaching should be judged by the criterion of what is of greatest immediate worth or nearest to the pupil's interest at the moment.

In the medical schools we see a trend to lay less emphasis on the values given to the premedical candidate by the sciences and more emphasis on a training which provides breadth, background, and perspective. An all-

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round high-grade scholar, even though he has a minimum of science, they say, is likely to become a more outstanding leader in medicine than the young, highly specialized scientist.

To those who call for the introduction of the practical, we would reply with a statement made by E. B. Wilson in 1915. "But civilization does not live by practical efficiency alone, neither is education merely a matter of vocational training. Something larger is here involved. What is the greatest service of science to our intellectual and spiritual life? And this, I take it, is only another way of asking: What is the value of science in general or liberal education?"

Wilson continues as follows: "There are certain obvious aspects of the question that will detain us for a moment only. Science should teach us to keep an open mind; to look facts straight in the face. It should help to deliver us from the deadly vice of thinking that we know things of which we are really ignorant. It should lead us to place a higher valuation on observation and experiment than on authority and precedent. We should, of course, acquire some definite information concerning the material world; we should become aware of the fundamental order that is discoverable among natural phenomena; we should gain an intelligent view of man's place in nature." "The main service," he says, "of science to our intellectual life is to help preserve us from a certain disorder of the imagination * * . It should adjust our vision to the larger meanings of things in the material world. And by this I mean to say that science should develop —and it should discipline—the constructive imagination."

As regards the medical school's search for the all-round scholar, we would call attention to Keller's paper on General Practice, in which he says, "The fact is emerging that the teacher has not been thinking about turning out a well-rounded human product" and that there is some ground for saying that the university "is a place where a concourse of scholars pursue research, and where the young may resort to pick up what they can." While this is an extreme pronouncement, which was more true a decade or two ago than it is today, it does keep some able and promising youths from entering the teaching profession. Keller is of the opinion that North Americans are content to stress some one aspect of development to the neglect of a well-rounded whole. This does not produce the much to be desired breadth, background and perspective; instead it leads to a narrowly circumscribed mind that is likely to become case-hardened, opinionated and senile pretty early. Keller says: "Not only should specialization within any one branch of knowledge be but sparingly prescribed for the average student, but all specialization should be resolutely held up until the process of exposure of mind is as nearly complete as possible. If we

are to have a really significant course of study, with a degree at the end of it which will mean something and which will elevate the teaching profession that provides it and the college that confers it, we must send out into the world, each June, not a few specialists and several hundred more or less mishandled non-specialists, but a body of well-rounded products, fit in any case to form the understanding clientele of the great genius when fate vouchsafes that rare, and so often unappreciated, boon to men."

We question as to how far the building of a broad intellectual foundation should be carried. Most of us, I believe, will agree that a fundamental education should include a good training in language, mathematics, some of the humanities, and science. We believe that education cannot be symmetrical without training in all of these and that "upon these as foundation stones, the tower of special knowledge may be carried as high as the builder can."

Our object as educators is to develop intelligence in the youths who come to us, to train them to be industrious, and to inculcate in them a realization of the value of integrity. History seems to indicate that in all ages the outstanding teachers have been those most concerned with the development of the individual student. This has demanded that the pupil be treated as an individual and has indicated that this can best be done in his major department. Large classes do not lend themselves to finding the characteristics of the individual's mind.

It is a mistake to believe that every experience in college and university courses is equally important. A broad foundation is desirable, but this does not require that the foundation be bedecked with bric-a-brac. Psychologists have rather clearly shown that skill acquired in one branch of learning is not transferred to another branch. Granting this, such important questions as these arise: When should the acquirement of the special skill of a profession begin and how far should this development proceed before the professional course is undertaken?

A recent pronouncement by the Medical Curriculum Conference of Great Britain attempts an answer in the following quotation: "The ideal approach to clinical study is by a university training leading to a degree in arts or science. The advantages of working for a degree in arts or science, in addition to the necessary period of study for a medical qualification, are obvious. The medical student comes into contact with men working at other subjects and preparing for other professions and listens to lectures by teachers whose concern and interest in life are the development of their own branch of knowledge. Moreover, it is good for the medical student to work in the laboratories with men who are destined for careers

in science other than medicine and who are interested in science from many and different points of view. The Conference recognizes the advantages enjoyed by those students who are able to devote one or more additional years to the study of the natural sciences as a prelude to and in preparation for their professional training. They recognize that such men, coming as they do from courses of study and research which have not been devised exclusively for medical students, bring with them new ideas and a fresh outlook which is of great advantage to the development and progress of the science and practice of medicine."

The Conference also states that "in the long run a scientific outlook, if once acquired, will prove of more lasting value than a store of knowledge * * *. It is, however, impossible to inculcate general scientific principles, without the introduction of much concrete knowledge."

These remarks lead me to conclude that undergraduate training of premedical students may be expected to provide a broad intellectual foundation in which breadth, background and perspective are emphasized; that it may be expected to inculcate habits of industry and of accuracy and promptness in formulating judgment; and that it should be expected to provide a beginning in the acquirement of those special skills which are of importance in the practice of medicine. Since medicine is an art as well as a science, cultural subjects should be given greater consideration than has often been customary in the past. Furthermore, it should be admitted that too much emphasis on the scientific side sometimes tends to make the student unsympathetic and cold-blooded in dealing with human life. Lastly, a working knowledge of biology, chemistry, physics and mathematics is a necessity. Yet I see no reason for demanding that any of these subjects should be taught from the medical standpoint and cannot agree with a recent article on physical therapy in which the author maintained that the present undergraduate course in physics should be rearranged so as to be a "more satisfactory course in truly medical physics."

We turn, now, to a consideration of biology and its relation to medicine. Should we ask if the two are related when it is so well known that the workers in both fields are always confronted with that all-absorbing problem, the mystery of life? The biologist confronts this mystery in a broader search than the student of medicine in that he extends his investigation to include all living organisms, while medicine limits its search to the mystery of life as he finds it in man. Both must use much the same tools; namely, such of those of chemistry and physics as may be applied to elucidate the common mystery. As Zinsser has well said, "The great mystery of life will be revealed as a physico-chemical process." Both, the

student of biology and of medicine, must keep abreast of the advances in chemistry and in physics in order to be able to grasp the new tools that are to help reveal the mystery of life. But let us not forget that neither biology nor medicine is merely applied chemistry and applied physics. We are just beginning to become acquainted with the biophysicist; the biochemist we have known for some time. Experience has shown that the good biochemist is not merely an organic chemist who dabbles in biology, but that he is also a well trained biologist; that is, he has the biologist's understanding of the living machine, as it is found in one or more kinds of animals or plants. So, too, the biophysicist will be a physicist who takes a place among biologists to learn from them of the mystery of life and to collaborate in the solution of this mystery.

Biology is defined as the study of matter in the living state. If this definition is correct, biology includes within its borders biochemistry, biophysics and medicine.

The medical schools require as a minimum one year of college biology or general zoology as a preparation for the study of medicine. This raises the question as to whether a working knowledge of biology can be acquired in a one year college course with sufficient fullness to be of value to the student in his medical training. Biology is such a broad field that an introductory course in it cannot have the definiteness of organization that is found in mathematics.

The course occupies a peculiarly significant and important place for many who elect it. Here, most of the students make their first contact with the subject; hence, it will have much to do with the formation of future interest. Among those who elect the course will be some who believe they are by nature and ability fitted to prepare for medicine. For them the introductory course in biology may crystallize or destroy this belief. Other sciences are not in a position to do this. Any teacher of biology of long experience can cite many instances of men who have become leaders in medicine who found their interest in the subject in the introductory course, sometimes as late as their senior year in college. He can also cite many instances of men who were persuaded to turn to other phases of biology or specialize instead in another field of learning. The introductory course frequently stimulates a lifelong interest not only in biology and medicine but in public health, in agriculture, in forestry—and other fields of human welfare.

We do well, however, to bear in mind that it is not the function of this first course to serve as a feeder for the biological sciences. In all our colleges and universities a large majority of those who elect the course will

not get any more biology. It is only a comparatively small number who will pursue the subject further as a preparation for teaching, investigation, professional fields, or for the joy of attempting to unravel nature's secrets. It is this majority, who elect the course for generalization, that is entitled to first consideration when the course is planned.

Some educators suggest that two introductory courses be offered: one cultural in character, for the majority, and the other highly technical, for those who are to specialize in biology. The cogent objection to this separation is that interests discovered while in college have shaped the careers of many leaders in science and education.

It may properly be asked whether it is possible to give a single course which will meet the needs of these different groups of students. The experience of the past answers in the affirmative. One of the present day difficulties arises from the demand for popularization, for a presentation of the high lights, for the elimination of the laboratory, and for the elimination of all technical terms from our vocabulary. While this demand is made somewhat noisily, it is not, as yet, a widespread trend.

If we assume that every liberally educated man should have certain biological information, the question arises as to what this should include and who should give the course. A glance at the large output of introductory textbooks will reveal that there is a surprising degree of agreement as to what are the broad principles which should be taught, but that there is considerable divergence of opinion as to what sources of information should be used in the presentation of these principles. There is also complete lack of agreement as to the order in which these should be taken up.

It is generally conceded that the course should be broadly educational and cultural and that the training can be made of value to all classes of students. A majority would select from the vast field of biological learning those facts and ideas which are likely to mean the most in the life of the average educated man and woman. As Nichols has said, "The value to the student of biology or zoology as a cultural study lies quite as much in methods acquired and in facts observed as it does in information received. First and foremost, the student should be taught to be careful in his technique, to be precise in his observation, to be thorough in his attention to details, to be keen in finding things for himself, to be accurate in his conclusions." The course should set forth in bold relief the great facts and leading ideas which touch human life in its combined hygienic, economic, industrial, intellectual and esthetic outlook.

There is a question whether the presentation of the fundamental phases of the subject necessitates the use of both plant and animal studies or the

use of animals alone. In the past, but in lesser degree today, the general biology course was a hybrid course in which an attempt was made to interweave a study of plants and animals to illustrate principles common to all life. Frequently, this resulted in a course of two parts: one dealing with plant life, or elementary botany; the other with animal life, or elementary zoology. Today a teacher is rarely able to present both aspects equally well; the botany, as a rule, suffers thereby. For this reason, more than any other, there is a growing disposition to make general zoology the introductory course. This, the writer regrets when he recalls to mind students who have been inspired to become plant geneticists, foresters and the like by the hybrid type of course.

That no single formula for the introductory course is universally acceptable is abundantly shown by the diversity of the table of contents of the introductory texts. There is a drift toward placing emphasis on the mammalian aspect. The reason for this is expressed by Henderson. He writes, "Now, it is nice to know about amebae and frogs and the germination of seeds, but a lawyer, or an engineer, or a journalist, or even a doctor, can get along and yet know very little of such matters. If, however, he has no notion of his own insides—of what purpose his food serves, and of why he keeps breathing—well he simply is not an educated man." He says further, "The student should begin, therefore, in that field in which knowledge of function has been most highly developed, a field which has the most powerful appeal for a human being, the field of 'human,' that is, mammalian physiology * * * ."

The recitation course has been to a considerable degree relegated to the past in that its main attainment is the cramming of facts into the student and an overemphasis on the subject matter rather than a useful understanding of fundamental methods and forces which guide and control living organisms. The lectures, textbook, other assigned readings, and the laboratory work should all be coordinated for the purpose of developing a self-reliant and reflective student who may, if he so desires, be able to pursue independently further studies of his own choosing in the broad field of biology.

The position and the value of laboratory work for beginners are being questioned. In at least one of our large state universities serious discussion has been given to the feasibility of completely eliminating the laboratory work and of substituting in its place demonstrations. It would be well, as we discuss this problem, to recall that in those days when proponents of science teaching had to battle for "a place in the sun" the driving force of the movement was the stress on the value of the laboratory method.

Professor Ivy said: "No one acquainted with the history of progress would deny that scientific investigation or the purposeful use of the experimental method has played an outstanding rôle in the elevation of man from barbarism to civilization, and has been the sole agency in visualizing for man the awe-inspiring facts concerning the world in which he lives and the universe of which it is a part."

Up to the present, no adequate measure of the value of laboratory work to the student has been developed. This, however, should not deter us from admitting that it may and does have real value. As Miss Greenbie says, in Arts of Leisure: "To be valuable, our reading should be supplemented by seeing." As tourists the majority of mankind find excitement and satisfaction in going to see those things about which they have been reading. Then, having seen, they come home to read everything in the library about the things they have seen. The laboratory should be and is, where properly conducted, a place where students get first hand experience with living organisms, with the end in view of answering questions which for them can only be answered by contact with natural objects. By this experience a better understanding and clearer interpretations of the principles of biology are obtained.

In the laboratory the eyes are trained to see more accurately and completely, and the hand, in drawings and written description, to record what is seen. Laboratory work should never be dominated by anatomy. The organisms used should not be studied as representatives of groups but rather as sample animals of convenient form for observation, and suitable for illustrating principles. Coulter, a botanist, well expresses a reason for some careful anatomical work in the following quotation concerning an introductory course: "It should always be synthetic. Fundamental in the synthetic presentation of botany" (and we may add zoology) "I should say is morphology, for I do not believe that any effective work can be done without some knowledge of the structure involved. Then, I should say, that the morphological thread that runs through the course should string together the most important physiological phenomena as explanations of morphological structure. In fact, I would not regard any morphology as significant that could not be explained in terms of physiology; and, on the contrary, I would not regard any physiology as worth while that could not be fitted into morphological structure. In other words, I cannot divorce the machine from its work." Dissection of enough kinds of organisms to give an appreciation of the variety of ways nature has of accomplishing an end will not be a waste of time for the student.

Certainly laboratory work should not be a cramming process. The

ideal to be sought is that of joy in seeing nature at first hand. As far as possible, the work should be in the form of problems that demand the drawing of conclusions from things seen. The use of the laboratory as a place to verify the statements of a guide is deadening in interest. There is an abundant reservoir of experience which can be used to develop initiative and independence of thought and which will stimulate students to draw conclusions from observed structures and their actions.

While the introductory course in biology does not have the definiteness of organization that some would like to see it have, I do not find that we are in danger of sacrificing a training in exact thinking. "Trial-and-error" methods have worried us; but through them all we have kept, or shall I say attained, a course in which the training cultivates painstaking and observant habits and encourages independent and intelligent reasoning. It deals with those facts and ideas that are likely to mean the most in the life of the average educated person. The student leaves the course with some knowledge of the methods of biology, and with a fairly clear understanding of life's principles.

We return now to the question, can a working knowledge of biology be acquired in a one-year course of college study with sufficient fullness to be of value to the student in his medical course? My contacts with students as they have progressed through their medical training convince me that an adequate knowledge is not acquired in the introductory course. Carlson has well said that the scientific method should, as a conditioned reflex, become a part of the daily thinking and behavior of the student of medicine. The biological side of this reflex cannot be established firmly in a course that has so much of the survey feature as does the introductory course. Furthermore, it should be recognized that conditioned reflexes are easily lost by neglect of use. The introductory course in biology is usually taken in the freshman or sophomore years. The break between this and the time of entrance to the medical school, therefore, is pedagogically bad.

Biology has techniques and information for the premedical student which, if thoroughly acquired and properly related, are of great value in the acquisition of the more strictly medical training. The advanced biological courses in our colleges and universities do not continue along the lines of the introductory course. It is recognized that to become a zoologist and to prepare for certain professions it is necessary to have a systematic knowledge of important fields in which the acquisition of facts may seem to outweigh principles. Helpful and important subjects, from which the undergraduate may select, are comparative anatomy of vertebrates, comparative and general physiology, experimental embryology, experimen-

tal zoology, genetics, protozoology and parasitology. In all of these subjects we are interested in the discovery of nature's ways and means of doing things.

Stockard, the anatomist, has said: "A real understanding of gross human form and structure necessitates an accurate knowledge of the processes of heredity, a clear conception of the many phenomena which have occurred during embryonic development, a knowledge of postnatal growth and differentiation along with an appreciation of the many internal and external influences which may modify the developmental course during its various periods. An approach to such an understanding will be deeply essential for a truly scientific conception of the differences among human constitutions." This statement is quite in accord with the experience of the biologist, to the effect that comparative anatomy, experimental embryology and some histology are indispensable to biological progress.

A knowledge of the comparative anatomy of the lower vertebrates certainly is helpful, if not indispensable, for an understanding of the human body. Furthermore, in comparative anatomy the student acquires a skill of importance, there he learns to dissect rapidly and well. "It is absurd," said President Eliot, "to begin with the human body the practice of dissection." There never has been any better training for the hand, eye and mind than that which is gained in securing a good understanding of the comparative anatomy of the vertebrates.

Down to the beginning of this century, embryology was quite content to observe the changes of form which take place as the egg passes through its embryonic stages in molding itself into the likeness of its parent form. As a science it concerned itself with description and neglected the physiology of development. Even today, "chemical embryology" is largely descriptive. Morgan says: "We have only begun to get information as to the 'organization' of the egg on the biological level and know as yet very little about the chemistry and physics of development." Today embryology is using the experimental method as a tool to discover the nature of the visible phenomena of development. It is revealing the organization of the egg, its organ forming substances, the arrangement of materials in gastrulation and the organizers. These investigations and experiments with egg fragments, separated blastomeres and transplantations are topics as profitable for the premedical student as for the biologist. That modification of the physical and chemical environment of the embryo will alter the pattern laid down by the chromosomes and their genes and thus produce an anomalous structural condition adds to the value of this study and emphasizes the modern viewpoint which is that the essential problems of biology are questions of dynamic relationships.

Beginning with the rediscovery of the Mendelian laws of inheritance early in this century, one of the most amazing developments in the whole history of biology has taken place. Genetics is now clearly accounting for the inheritance of many normal and abnormal conditions of body and mind. Much of this information is of value in preventive medicine. Yet, while it is well known that heredity plays a tremendous rôle in the origin and occurrence of disease, these facts are not reaching the practicing physicians. Robb's paper, "Discrepancies of Etiology in Ten Medical Textbooks now used at Syracuse University,[1]" indicates that medical authors also are not well informed regarding the methods of inheritance.

In closing, we do well to recall a statement made by Dr. Rufus Cole of the Rockefeller Institute for Medical Research. He said: "The methods and accumulated results of all sciences must be used in pursuing the science of medicine. That some of these sciences are more closely related to medicine, in their methods and fields of endeavor, than are others is obvious. Biology, comparative anatomy, embryology, bacteriology, protozoology, certain branches of botany, anthropology, human anatomy, human physiology, psychology, and even certain aspects of the social sciences, have many close affiliations with medicine * * * . But none of these contributing sciences are medical sciences. None of them should be trammeled by serving medicine alone."

1. J. Assn. Amer. Med. Colls., September, 1935, p. 295.

Undergraduate Chemistry in Relation to Medicine*

HARRY N. HOLMES, PH. D.
Professor of Chemistry, Oberlin College
Oberlin, Ohio

The medical profession has been accused of being slow to appreciate the chemist's discoveries, in spite of the significant fact that Pasteur was a chemist. If there is any cause for this criticism, it must be due to lack of time for adequate training in chemistry in the strenuous life of medical and premedical students.

And yet Dr. John J. Abel once remarked, "When a young man planning a medical career asks me how much chemistry he should take in college, I advise him to take all he can get, certainly not less than three years of it."

Dr. William J. Mayo insists that "the great advances in medicine of the future will be not only chemical but colloid-chemical." A brilliant bacteriologist, now Dean of a famous medical school, tells me that bacterial toxins which, after all, are chemicals, must be attacked by methods of the chemist as one part of the campaign against disease.

None will deny that the human body is a complicated laboratory operating with chemical reactions. Nearly all life processes, even digestion, are chemical. Body regulation by hormones and vitamins, the functions of compounds of iron, iodine, copper, sodium, calcium, magnesium and such elements, the manufacture and use of medicines, antiseptics and anesthetics —all are chemical. Consequently, premedical training must be strongly chemical with an appropriate share for the other required courses and for cultural breadth.

In the presentation of the plan outlined below, I have been influenced by the opinions of more than twenty-five able teachers of chemistry whom I consulted and by thorough testing of the main features of the plan for twenty-one years at Oberlin College.

The majority of premedical students will probably not find it possible to take the four-year college major of general chemistry (including qualitative analysis), quantitative analysis, organic chemistry and physical chemistry, and yet all these courses are fundamental to modern medicine. They should be taken, if at all possible, for medicine is no longer to be called a purely biological science. It is a chemical science as well. The setting up of "minimum requirements" on the part of medical schools certainly does not mean that better preparation is impossible.

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It seems eminently worth while, then, to persuade the men of medicine to increase their requirements of college chemistry somewhat and to advise premedical students to make sure of at least three years of this subject. This limitation apparently forces physical chemistry out of the picture yet some of its benefits may be secured if the suggestions offered later under "Quantitative Analysis" are adopted.

With your permission I shall refer to some time-saving features of the plan long in use at Oberlin, a plan that has worked successfully for many able men now teaching or practising medicine.

GENERAL CHEMISTRY—The laboratory work during the second semester of this year should be devoted to reactions of the metals and the simplest possible outline of qualitative analysis. Qualitative analysis is not an end in itself but merely a means of learning more chemistry. It is an excellent course for training in system, classification, comparison and application of properties—all very scientific, and obtainable in the time allotted above. We find that a good chemist, well disciplined in other courses and this minimum of qualitative analysis, can, when need arises, use quite readily the more extensive and specialized manuals on the subject. One of our students once had trouble in gaining entrance to a great medical school because the Dean ruled that our catalog failed to list qualitative analysis as a separate course. In vain did we argue that this boy with his four years of chemistry could handle all the qualitative demands that could possibly face him in the medical laboratories.

The same course in the first year of chemistry can be taught so that it serves all classes of students equally well. They all deserve a few chapters on the compounds of carbon, nutrition and colloid chemistry. In practise, the latter chapter appeals. How fortunate, too, for the future physician, along with others, to get an introduction to interfacial tension, emulsions, the hydrated proteins, adsorption and related topics that have so much to do with the life process.

Fact stuffing has no place in this introductory year but rather a discipline in close observation and scientific reasoning, so useful later on in medical diagnosis. It is a great game for the teacher, and most stimulating for the class, to interrupt a student reciting the details of some great achievement with the question, "If you were in Lavoisier's shoes (or Sir William Ramsay's), what would you have done next—and why?" Here begins the research attitude of mind.

"One book students" never go far, so intellectual dividends are guaranteed when a freshman shelf of selected books for outside reading is made accessible. Nor can the journal reading habit be started too early. The *Journal of Chemical Education,* which is far more than its name promises,

and *Science News Letter* should be taken out of the library and exposed in the lecture room or in a window seat near the entrance to the laboratory. Such wares sell when they may be had for a mere reaching out of the hand.

QUANTITATIVE ANALYSIS—The essential accuracy of quantitative work, its nicety of manipulation, would be good in any field of education. How vital such training is for the physician is easily imagined. More than one-half of the student's time in biochemistry, as taught in some medical schools, is occupied with quantitative technique. One semester of college quantitative drill is the least that should be permitted and a full year should be urged.

In my own opinion, shared by many other teachers, the ideal second year of chemistry for all purposes is quantitative analysis taught in lecture and laboratory from the physical-chemical point of view. Nothing better could be taken by the premedical student for he gets better quantitative and a good introduction to physical chemistry at the same time—very forunate, indeed, if he lacks time for more than three years of undergraduate chemistry. Professor W. H. Chapin on our staff wrote the books necessary for such a course and they have served their purpose splendidly.

If this second year course is to be kept modern, it must continue the contact with colloid chemistry begun in the first year and should call attention to the possibilities in microchemistry. To stimulate originality, students ought to be encouraged to devise new quantitative methods or small improvements in technique. These need not be tested, but friendly discussion will do something for intellectual muscles. Perhaps, only the gifted few will respond but they are tomorrow's leaders.

ORGANIC CHEMISTRY—No college course is more fundamental to medicine than organic chemistry; so, one semester of it, even with three lectures and two half days of laboratory work per week, seems rather inadequate. A full year will not be wasted in the life of a physician. The tissues of the body are largely organic, as are most of the medicines, antiseptics and anesthetics. The discipline involved is almost as good as a formal course in logic.

Special short courses, possible in larger institutions, are out of the question for small colleges. For that matter, the training given in the standard type of course is probably best for all types of chemistry students. Only in the laboratory part of the course need there be variation for the benefit of the medical prospect. In individual instances fewer organic preparations and more drill in reactions and tests may be substituted. Any good teacher will stress the proteins, carbohydrates and fats and give a

little time to enzymes, vitamins and hormones—for such topics are important to others in the class as well as to premedical students.

PHYSICAL CHEMISTRY—If the future physician can possibly manage more than three years of chemistry he will profit greatly by at least one semester of physical chemistry. With a large faculty it may be possible and even advisable to arrange a short specialized course for these students. In any event, the usual experiments in the laboratory should be varied a little to suit individual needs. Much medical research is of a physical-chemical nature and is best understood and utilized by practitioners with adequate chemical preparation.

* * *

In the last two years in college, premedical students might well be advised to read short introductory texts on biochemistry and colloid chemistry. Recently, I wrote a 200 page introductory colloid chemistry to meet this and other needs, while other authors have provided similar texts on biochemistry. It seems strange that medical men work with the colloidal tissues of the body and colloidal processes of health and disease yet as a class their knowledge of dialysis through cell walls, adsorption in cells, water swelling of proteins, fat embolism, colloidal elements in cancer therapy and similar topics is somewhat limited.

Some familiarity with a chemical library is good for any undergraduate, and a man continuing in medical science should certainly know how to consult *Chemical Abstracts*. He might even glance through a few copies of the *Journal of the American Chemical Society, Journal of Biological Chemistry, Biochemical Journal, Journal of Nutrition* and *Journal of Chemical Education,* just to learn that they contain papers of importance for him and his specialized interests. A single report on a typical research paper, selected carefully by the staff, with a brief outline of the observation or need that occasioned the research, the status of knowledge up to that time, the plan of work, the apparatus and technique used, and the results and conclusions would do much to develop appreciation of research.

I sometimes hear older men on medical faculties deprecate too definite premedical requirements, definite as to courses in science. In praising general culture, they overlook the general college practice of requiring a long major in one subject with breadth of election in certain definite fields. We believe that the truly educated man knows something about several subjects and a great deal about one subject. The student must go well beyond the first year in any field to learn its methods. Lax requirements by the medical school or college may set up a premedical major that misses the scientific method entirely. Three years in chemistry or even three years in biology must be the backbone of an adequate premedical major.

Many of us believe that it is not enough to supply the best possible college training for students expecting to study medicine later, but that it is in the interests of humanity to secure an adequate number of the most brilliant men for the medical career.

Under present economic conditions, we learn every year of hundreds of men, qualified by training, natural ability and personality to become brilliant leaders in the medical profession, who are forced by the $5,000 to $6,000 cost of a medical education to select some other career. It may be argued that we have too many doctors now, and that there is no occasion for encouraging more students to enter this field. However, we are vitally concerned with the small number of especially brilliant men to whom medicine must owe its great advances. Humanity must not fumble the opportunity of securing the abilities of such men for medicine, regardless of their financial rating.

Concretely, it might be a very good thing for the foundations and those generous individuals who now support medical schools, hospitals and medical research, to strengthen their program by aiding, to some extent, a relatively small number of the most promising premedical students in our American colleges to finance their medical training. It would not be extraordinarily difficult to secure reliable recommendations from our best colleges and our best teachers of chemistry, biology and physics.

Physics and the Premedical Student*

K. K. Smith

Professor of Physics, Northwestern University
Evanston, Illinois

When your secretary, Dr. Zapffe, invited me to take part in this symposium, dealing with medical education and the natural sciences, I gladly accepted; for I recalled that, some years ago, my landlord expressed the opinion that physics has "something to do with pills," and only last summer a young cousin of mine, about to enter high school, guessed that physics has "something to do with hygiene." So, with this running start, I approach the topic of medical education and undergraduate science.

In the monumental report of the Commission on Medical Education, your Association has rendered a great service not only to medical education, but also to general education. Among other results of this report may be mentioned, perhaps, the appointment, by the American Association of Physics Teachers, of a Committee on Premedical Physics, which might better be called a Committee on the Teaching of Physics to Premedical students. Although I have the honor to be a member of that committee, I do not speak in its name.

The Third Report of the Commission on Medical Education (Oct. 1928, p. 11) opens with these words:

"Medical Education is one of the most important fields of higher education and as such should be considered not as an isolated problem of professional or vocational training but as an integral part of the whole question of higher education. In this field, the unit of education is the student, not the curriculum; and the most important accomplishment to be sought in medical education is the development of responsibility in the student for his own training." I agree most heartily with this statement which chimes in beautifully with the inspiring remark of President Gilman at the opening of Johns Hopkins University, "Gentlemen, you must light your own candles!"

What I want to consider with you is the particular question of physics and the premedical student. I assume that he has lighted his own candle and that he is asking "what does physics offer me on my way to becoming a successful physician?" In the *New English Dictionary*, he finds that the

*Owing to the untimely death of Professor Smith, this paper was read by the Secretary, at the Forty-sixth Annual Meeting of the Association of American Medical Colleges, held in Toronto, October 28-30, 1935.

primary meaning of the word "physician" is "A student of natural science or of physics." But oddly enough this definition is marked with a dagger, denoting that it is obsolete. It is not uninteresting to note, however, that in France this is still the current meaning of the word "physician." In the dictionary's second definition, the student finds what he wants, namely, "One who practices the healing art, including medicine and surgery." This is what, from his earliest childhood, his family physician has meant to him.

By this time the student's curiosity is aroused and he looks up the word "physicist," only to find that when first used, in 1716, it denoted "one versed in medical science." He notes that this definition also is marked "obsolete and rare," which, of course, he will find to be true as he makes the acquaintance of physicists. The young man is now skeptical and begins to ask whether there is any connection whatever between the study of physics and the attainment of his goal in medicine. Let me try to answer this question of the premedical student as to what opportunities he can find in the study of physics and what help he can reasonably expect from his teacher of physics.

1. First of all, the physical laboratory offers him an opportunity to see, under conditions which are relatively simple, just how the mode which we call "scientific method" has developed. Here, if ever, he will learn the profound truth of the late Professor W. S. Franklin's remark that "Science is finding out and learning how."

As an example of scientific method, one may cite the experiment performed by Galileo, the father of modern physics, to determine the distance a body rolls down an inclined plane during a given interval of time. He was not concerned with the ball's size, color or composition. He cast aside all considerations except the quantitative relation between the distances and the times. The result of the experiment was the discovery of the law of falling bodies. Here, it must be admitted that the usefulness of the law is greatly enhanced by the fact that it can be expressed in simple mathematical form. It might be added parenthetically that the debt which students and teachers of science owe to the mathematician is very great. The mathematician is, indeed, the best friend of the student of natural science; for he gives the clearest answers to their questions. For the moment, I have forgotten who it was that spoke of mathematics as the language which men of science talk when they have learned to talk most clearly.

For other norms of scientific method, let the student read the story of Tycho Brahe's observations of the planets, of Kepler's empirical laws based on these observations, of Newton's law of gravitation summarizing

Kepler's work, and of the prediction and discovery of the planet Neptune. Or, let him note the predicted time of the next lunar eclipse and verify, with his own eyes, the fact that the astronomer is able to predict this to the second.

The student sees the eclipse with his eyes. Yes, but with his intellect he sees one of the most striking illustrations of what good scientific method can do when conditions are simple. The fact that this illustration has not had any applications in commerce, industry, engineering and medicine does not detract from its value as an answer to the student who wants to know what the method of science is. Surely, it is good for the premedical student to see and ponder this illustration.

2. Secondly, the physical laboratory offers him simplicity of conditions for observation and experimentation. Physics does not have a monopoly on scientific method, but the historical fact that vital processes and nearly all transformations of matter (chemical phenomena) have conventionally been excluded makes the materials of physic especially simple. The bodies are not alive; they do not usually burn, or change color; they seldom explode. I shall refer later to the criticism sometimes made that the laboratory of physics is barren of vital phenomena. At the moment, I am merely pointing out that the principles of physics can be illustrated by the use of inanimate objects—"sticks and stones," if you will. Is there not something to be said in favor of choosing experiments in which the material is patient, and the student can repeat his observations over and over under essentially the same conditions? Then, he has the conditions of the experiment under control, and can give his attention to accurate observation. This point must not be stressed too much. Was it not Professor Michelson who once said that even a steel wire has "a coefficient of memory"?

The conditions under which the chemist, biologist, anatomist, physiologist, physician and surgeon must necessarily observe and experiment are vastly more complicated than the conditions under which the physicist is able to work. Is it not, therefore, worth while for the premedical student to acquire experience under simple conditions in order that he may later thread his way through the more complex phenomena of living matter?

3. Thirdly, the study of physics gives the premedical student familiarity with a certain set of concepts and principles which are fundamental in all the natural sciences. Among these useful concepts I have in mind the notion of pressure, rate of flow, momentum, work, energy, temperature, electrical charge, electrical potential, resistance, vibratory motion, waves and resonance. The value of these concepts depends largely on their clearness and definiteness, and also on one's understanding of how these

quantities are experimentally determined. Thus, Ohm's discovery that, under certain conditions, there is a constant relation between the electromotive force and the current in a circuit enables the student to predict many important phenomena with reasonable assurance. When it comes to circuits containing an electrolyte or living tissue, the student may not assume that Ohm's law can be applied in its simple form, but surely the idea of electrical resistance and Ohm's law is worth carrying from the laboratory of physics to the laboratories of chemistry and physiology where it will, at least, serve as a norm. If one expects clear answers, one must ask clear questions.

The student who approaches the career of a physician, like one who is entering the profession of engineering, may become impatient as he attempts to master these precise ideas of theory. But when he realizes, for example, that the kinetic theory of gases gives him a reasonable explanation of Charles' Law and Boyle's Law, he feels that he has grown in intellectual power, that things are becoming simpler, and that his efforts have not been wasted. The phenomena of sound are seen to be produced by the vibration of certain bodies. Magnets lose something of their mystery when the effects of moving electricity are studied carefully.

In acquiring these fundamental ideas, the premedical student feels, at times, that the course of treatment recommended by his advisers is not showing immediate results. Here is a call for faith—the same kind of faith which he, later, as a medical practitioner, will expect from his own patients. However, it is not necessary for him to believe entirely without evidence; for the history of physiology and the medical sciences makes it clear that the principles of mechanics have helped in studying the behavior of the heart and the circulation of the blood; that the laws of optics are indispensable in the treatment of vision; and that the principles of heat, electricity and radiation are employed in physical therapy.

Many of these valuable elementary and essential ideas have come from men working in other fields than physics; not a few of them, indeed, from physiologists and physicians. Professor Magie's illuminating *Source Book in Physics* (just off the press) gives many such instances. The premedical student, in considering energy and its transformations, will find an incentive in the fact that the word "energy" was introduced, as a quantitative concept, by a practicing physician of London, Dr. Thomas Young. This same student will be interested to learn that it was a German physician, Dr. J. R. Mayer, who was the first to conceive and enunciate the equivalence between heat and mechanical energy. It was, indeed, as a young physiologist and army surgeon that Helmholtz gave the first convincing arguments for the general application of the principle of the con-

servation of energy—a principle which Maxwell later characterized as "the one generalized statement which is found to be consistent with fact, not in one physical science only but in all." The eager premedical student will certainly ask himself whether this principle is also consistent with fact in the biological sciences.

Among these fruitful, fundamental notions is the idea that electricity is atomic. It was Helmholtz who pointed out in his Faraday Lecture of 1881, that Faraday's laws of electrolysis, combined with the Dalton idea that matter is atomic, must lead to an atomic theory of electricity. The later discovery of the electron and the determination of its charge are known to students of science everywhere. If it be objected that the medical practitioner is not concerned with the atomic nature of electricity—that all he needs to know is what electricity will do, it may be pointed out that the concept of the electron is an invaluable tool in the explanation of electrical and spectroscopic phenomena; indeed, it seems now to be indispensable in understanding chemical affinity with which the student and practitioner will always be concerned intimately. Can it possibly be true that the electronic theory will not find application in biological and medical questions?

4. Fourth and lastly, the study of physics offers the student an opportunity to understand, and, perhaps, to use, some of the instruments applied in medical investigations and practice.

It is here unnecessary to make a long list: the microscope, the spectroscope, the vacuum tube amplifier and oscillator, the galvanometer, oscillograph, polarimeter, x-ray machine. The premedical student does not need to be convinced of their usefulness; he has only to look about him when he visits a well equipped laboratory of physiology or a modern hospital. It is obvious that they are used, as Franklin said, in finding out and learning how. The importance of a particular instrument may wax and wane as medical science develops. Physical instruments are much less permanent than principles. Nevertheless, the value of a personal acquaintance with important types of instruments will hardly be questioned.

The extent to which it will be possible for the premedical student to realize the four opportunities which I have mentioned depends, of course, on many factors.

First and foremost, it depends on the student himself, on his native ability, on his voluntary efforts, and on his perseverance in asking questions.

Secondly, it depends, I should say, on his teachers and advisers, on their ability, on their efforts, and on their perseverance in helping him.

Thirdly, it depends on the organization of the college, on the curriculum and on the libraries, laboratories and material equipment available.

How largely the final result depends on the native ability and industry of the student is made clear in Dr. Zapffe's paper on the "Correlation of Accomplishment in the Arts Colleges and in the Medical School of the 1933 Freshmen Medical Students,"[1] where he shows that "the good students do good work, on the whole, in the medical school; the average students do average work; and the poor students do poor work." For example, "Fifty-two per cent of students who were ranked in the upper third of the class in the arts college received a similar rating in the medical school; 30.7 per cent dropped to the middle third: 14.5 per cent dropped to the lower third.

THE PRESENT PRACTICE IN REGARD TO THE STUDY OF PHYSICS BY PREMEDICAL STUDENTS

In spite of the fact that you are already familiar with it, I venture to sketch very briefly the present practice as regards premedical physics. In most colleges, the premedical student is enrolled for a course in general physics running through one year. He attends lectures and classes with students having other professions or no professions at all in mind. Ordinarily, he performs experiments in the laboratory that have not been specially selected with reference to his future career. The study of physics is supposed to absorb about one-third (or perhaps only one-fourth) of his time and energy devoted to academic study. Almost invariably he stands examination at the end of each semester; very rarely is he examined in physics after he leaves the course. There is little or no formal correlation of the courses offered in physics and in chemistry; this in spite of the fact that there is no real line of demarcation between these two sciences. Still less correlation is attempted between the courses in physics and in biology.

In closing, I wish to ask a few questions which strike me as pertinent: First, Should the study of physics be enriched by the inclusion of vital phenomena, or at least by more consideration of the application of physical principles in biology and in the medical sciences?

Professor R. W. Wood, now President of the American Physical Society, has driven a cat through a long spectroscopic tube to clean it of cobwebs. But this tube was part of an apparatus for optical research, not for teaching! Professor E. S. Ferry, in one of his books on Mechanics, has explained in a very entertaining manner just how a cat manages to land on its feet when dropped from any position whatever. In most laboratories and textbooks of physics, the only reference to a cat is that which

1. *J. Assoc. Amer. Med. Colls.*, May, 1935, p. 184.

employs its fur to help define negative electricity! In one of the old textbooks of physics, published in 1869, I find that animal electricity is listed as one of the five kinds: (1) frictional, (2) magnetic (3) thermal (4) voltaic (5) animal. Today, only two kinds of electricity are recognized—the positive and the negative. "Animal" electricity has disappeared, except in the sense in which it is studied in the physiological laboratory. Here is its proper place. Even Faraday, prince of experimenters, did not succeed in showing the well known electrical effect of muscular contraction in his own arm, a phenomenon which had already been reported by Dubois-Reymond from Berlin. In his *Diary*[2] for 1851, the great English experimenter remarks, at the close of his entry, "I suppose it is because I do not know how to proceed; still I do not see any cause for failure if the effect be real."

On the other hand, The Life and Work of Sir Jagadis C. Bose is a volume which reveals how much can be accomplished by a physicist who is willing to give years of patient inquiry to physiological phenomena. It is not a question of drawing a sharp line between living and non-living matter. It is rather an attitude of mind which is involved, and which is well illustrated by a story told of the late Jacques Loeb, who, when once asked whether he was a chemist or a physiologist, replied "I am a student of problems!"

If you ask me to what extent is it profitable to raise questions about animate matter in the physical laboratory, my reply is that these in general may well be transferred to the biological laboratory or to the medical school; but this does not mean, of course, that one should banish from the lecture table all application of physical principles in biology and medicine.

The second question which I wish to raise refers to the need of a separate course in general physics for the premedical student.

The Committee on Education in the American Physical Society, whose report was recently republished in the *American Physics Teacher,* and summarized in your own JOURNAL for July, 1935, is inclined to give a negative answer. In this judgment, I heartily concur. Sound physics is one thing. The best we can offer in the physical laboratory is none too good either for the premedical student or for the prospective engineer.

A third question arises in regard to advanced courses in physics which premedical students may be advised, or even required, to take.

Few institutions, so far as I know, have advanced courses especially designed for this group. However, Professor Harrington of the Uni-

2. Vol. 5, p. 383

versity of Saskatchewan has described in the JOURNAL of your Association[3] his experiments with a second course following the original required course. This proposal is excellent in aim but, in view of the expense involved and on account of the student's limited time, I regard it as totally impracticable at the present time in most American universities.

The fourth and last question which I shall ask here is what kind of provision should be made for the pursuit of physics or its applications in the medical college?

Whether the student should make such advanced study entirely on his own responsibility, with the aid only of the library and laboratory, or whether he should be assisted by a teacher of biophysics and physical therapy, are questions demanding large medical experience and are matters for the medical colleges and for your Association to decide. I am not entitled to any opinion.

CONCLUSIONS

In conclusion, I want to invite your attention once more to the four rare opportunities which every premedical student may fairly expect to realize in the physical laboratory.

1. The first is a speaking acquaintance with that mode of procedure which lies at the base of all science, pure and applied, and which is known as scientific method.

2. The second is the possibility of working under conditions which are relatively simple and of thus training oneself for the more complicated surroundings of physiology, surgery, and drugs.

3. The third is the acquisition of a set of fundamental concepts and theories which serve one as a pilot in navigating the crowded and winding stream of medical literature and medical experience in the school, in the hospital, and later in practice.

4. The fourth is familiarity with the explorer's tools—the instruments which alone can furnish the data essential in forming correct judgments.

I have raised four questions which concern mainly the teachers of physics—a guild which always receives gratefully any suggestion looking toward the improvement of its work.

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3. *J. Assoc. Amer. Med. Colls.*, November, 1932, p. 362.

Preparation for the Study of Anatomy in the Medical School*

J. Parsons Schaeffer
Professor of Anatomy and Director of the Daniel Baugh Institute of Anatomy
Jefferson Medical College
Philadelphia

Although this paper could properly be limited in scope to a consideration of the direct or specific training deemed essential for the study of anatomy in the medical school, it is obvious that one cannot deal intelligently or fairly with the matter of undergraduate preparation for the study of any of the basic medical sciences as set forth in the medical curriculum without giving thought to the requirements involving the general questions with which the medical man must deal, as well as problems that are specifically professional. Thus, in dealing with the undergraduate preparation for the study of modern anatomy as required in the medical curriculum of to-day, one is at once concerned with (a) the general premedical requirements for the study and practice of medicine; (b) the specific prerequisite studies, having in mind the scope and methods of anatomy and the required correlation of certain phases of the subject with the other basic branches of medicine and clinical work; (c) the fundamental education and the primary steps in the special training essential in the furtherance of pure and applied anatomical research, both in curative and preventive medicine. The real promotion of the latter, of course, requires much special study after and during the medical course by those students whose tastes, ability and interests are in the morphological and kindred fields.

Medical education must be conceived broadly, and in bidding for curricular recognition of their subjects and making demands on the undergraduate program, premedical and medical teachers must understand that medical education as required to-day is more than an isolated problem of strictly professional training, and that the preparation for the study of the ancillary divisions of human anatomy must be planned accordingly. There must be, first, an appreciation of an appropriate general education. Moreover, relative values should have thoughtful consideration, and in planning the premedical education, there must be a clear understanding, both in instruction and learning, that there is no subject or field of study that is absolute or exists by itself. Learning that makes the coordination of subject matter possible in the solution of problems is fundamental. I

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say these things because, too often, there is a great imbalance in the undergraduate preparation, due, perhaps, to the fact that ear is given unduly to certain well-intentioned but over-enthusiastic and misdirected teachers who make excessive demands for their individual subjects and fail to see the problem as a whole.

Viewed from whatever aspect one will, the study and practice of medicine, if it is to take advantage of its opportunities and discharge with reasonable completeness its responsibilities, must be built on sound general education preliminary to the work of the medical curriculum, rather than being merely a narrow technical training in the so-called premedical sciences, albeit that from the outset a large part of the medical student's work requires and presupposes a comprehension of the basic principles of pure biology, chemistry, physics and mathematics.

Although premedical education must take cognizance of the need of prerequisite studies in anticipation of the work in the basic sciences of the medical curriculum, never must sight be lost of the fact that the medical student in the pursuit of such studies, anatomy, for example, will require the supplementary knowledge provided only by a general education, and that when he enters on his clinical studies and later becomes a physician engaged in practical work he will not only be concerned with specific professional duties and conduct but with important and often perplexing problems in sociology and economics and human relations in general. If this be true, and I take it all agree that it is, then those having to do with premedical education must see to it that the study and practice of medicine, which are more and more approaching the sciences, do not suffer by too narrow preparation in fundamental preliminary studies. This applies with equal force to the various divisions of anatomy. Indeed, it may be queried, and justly so, whether there is wisdom in isolating a group of students and designating it "premedical" and considering the preparation for the study of medicine peculiar, save for the requirement of obvious prerequisite branches of knowledge and the need of a wise and appropriate selection of material from those subjects which cover enormous fields and varied aspects for consideration; for example, biology, physics, English.

The preparation for the study of human anatomy as required in the medical curriculum presents another important side, namely, that, since there are few branches in the medical college in which the teaching and the comprehension of the subject matter do not require an understanding of the fundamental aspects of human anatomy in one or more of its ancillary divisions, the problems involved in the undergraduate preparation for the study of this subject concern not only the teachers of human anatomy but many others who have to do with medical education and medical prac-

tice. Viewed in this manner, the preliminary and basic training on which the satisfactory study, promotion and correlation of human anatomy must, in a large measure, depend, becomes more than a mere departmental matter.

Just what is a proper general undergraduate education preliminary to the medical course is not a simple matter to determine because so much depends on the individual student and the place of study. With three, and in very many instances four, years of undergraduate college work, the latter often with an academic degree, it should now be possible for the average student to enter on the study of the basic branches of medicine with a reasonably satisfactory fundamental education. Certainly, there is enough time and effort consumed, and when the training falls short of the needs, one is curious to know why and variously checks the subject matter; place of study—secondary school, college, university; teachers; and students as possible factors. Sometimes the fault is readily found and easily corrected; on the other hand, the problem may be much more involved and troublesome.

My experience as a teacher of anatomy in medical schools for nearly thirty years leads me to believe that the undergraduate training should include: English, with special and strong emphasis on the use of English in writing and speaking; history, stressing among other things civics and citizenship; German or French, better both, urging a better reading knowledge; mathematics, with a plea for a better mastery of lowly arithmetic before the higher mathematics are undertaken; Latin and Greek (want of time seldom permits the latter), because of their value in scientific reading and for general culture; electives among psychology, logic, sociology, economics and public speaking; and, of course, the important prerequisite studies in pure biology, chemistry and physics.

The amount of ground that can be covered and the choice of subject matter in the premedical preparation and training depends, of course, largely on the time given to the work, that is, whether two, three or four years are to constitute the undergraduate program. The fewer the years, the more difficult is the proper selection of courses and subject matter.

Having in mind the primary purposes of the premedical schooling and discipline, there is no need, as I see the problem, of going into the enormously broad scopes and intricate details of some of these subjects. In Latin, for example, a good preparatory school training may suffice, thus relieving the college load. Oftentimes, it is the more elementary and much needed aspects of a subject in which the student is deficient; for example, English grammar; proper use of English in writing and speaking; logical reasoning in the use of English. Some of these defects are, perhaps, prim-

arily the fault of the secondary school, but too frequently the college training fails to correct them. I would urge listing a course in logic as being highly desirable in the premedical preparation. As some one has said, "Logic is the science of correct reasoning. It teaches us how to discover truth; how to recognize it when discovered; how to arrive at general laws from facts collected by observation or experiment and how to deduce new facts from those already found to be true."

Care must be exercised not to overburden the premedical curriculum with required work. Already biology, chemistry, physics, English and a modern language and, in some instances, additional subjects, for example, embryology, are on the required list. Although they should in some form or other be included in the premedical training, the additional work in the languages, courses in mathematics, sociology, psychology, economics, logic, etc., should probably not be required specifically. The undergraduate program should have a number of elective hours, at least in the junior and senior years, and my belief is that it is desirable to give students some freedom in the choice of subject matter. Holding students rigidly to a prescribed undergraduate curriculum throughout is neither wise nor required. A thoughtful presentation before prospective medical students, outlining the important and varied specific and general questions with which the student of medicine, the practicing physician, and the medical investigator have to deal, will, as a rule, lead a student of proper type to cooperate wisely in the choice of elective premedical studies.

Too frequently short courses in human osteology, bacteriology, dissections on the human body, etc., are made part of the premedical training. This, I believe, is a mistake because such courses are, as a rule, not planned for the needs of medical students, albeit that they may serve well as informative and proper courses for non-medical groups. Especially is the inclusion of such courses in the premedical program open to question when they usurp much of the time which premedical students should be giving to the acquirement of a sound general education in appropriate and needed fields of study preliminary to the work of the medical curriculum. The medical school is the proper place for these subjects, for it is here that a suitable atmosphere exists and the proper correlations and applications can best be made. Then, too, large blocks of time are already set aside in the medical curriculum for the pursuit of these and kindred subjects.

The student himself is the most important factor, and when the learner is endowed with a strong personality and character and possesses unusual aptitude, ability, interests and industry, he would, in a manner, succeed in the anatomical and general medical studies and subsequently in medical practice with a minimum of premedical education. With pride we point

to a considerable number of medical men who have made epoch-making contributions to the field of medicine with very little preliminary training, and from this some would generalize and make light of a sound educational background preliminary to the study of medicine. Whether a basic college training would have made these otherwise favorably endowed men more effective in their medical work can not be determined. That they would have found much of the work easier and more comprehensible goes without saying. The thought occasionally expressed that a general college education preliminary to their medical work would have proved a handicap is groundless and scarcely worthy of consideration. Little or no reference is made to a larger number of men who never became top notchers yet might have done so had they had a better basic education, assuming that they possessed the native ability, industry, character, thoroughness, judgment, etc., required. These attributes should be inherent in the student from the outset. Education cannot supply these qualifications; it can only promote and discipline some of them. Frequently, we expect too much of education—to do what heredity and environment have failed to provide. Moreover, no matter how liberal the education may have been, some students never really qualify for the field of medicine.

When one compares the wide scope of modern anatomy and the required correlations and application as set forth in the modern medical curriculum with the narrower concept of anatomy even as little as three decades ago, one readily sees that the preliminary education of the earlier time, when anatomy did little more than serve as a handmaid to surgery, would be hopelessly inadequate to-day. Even the most apt student of those days would find it difficult to master the varied aspects of modern medical anatomy with so little premedical education.

When but one year of undergraduate work was required for entrance to medicine, the rank and file of students were apt to lack in sound preliminary education and discipline and because of this they were more or less handicapped from the outset, as compared with those who had taken additional college work. This did not necessarily mean that these students were lacking in aptitude, ability or interests, but there was little time for these attributes to take form and be disciplined before the heavy work of the medical curriculum overtook the learners. So many of the curricular hours had to be given to certain branches of study listed as required premedical subjects that too little time was available for an adequate consideration of the humanities and other basic cultural and disciplinary studies so essential for a well-rounded preparation.

In saying this, I appreciate that there is no clear cut division between the humanities and science generally; moreover, I would take a broad view

of cultural subjects. It is difficult to perceive why we should continue the tradition of listing certain subjects only as cultural in character to the exclusion of others. Biology, for example, in many of its aspects has outstanding cultural values, although tradition might not list it as such. In medicine and the sciences generally, a more liberal view can and should be taken in reference to cultural subjects. To do so would help in the arrangement of the premedical curriculum and would result in less crowding.

The more specific preparation required for the study and correlation of human anatomy as set forth in the medical curriculum becomes more comprehensible when one understands clearly the scope of modern anatomy. Anatomical study, teaching and research have to do with macroscopic or gross, microscopic or minute, and embryologic and developmental phases. The human body must needs be considered from the phyletic and the ontogenetic aspects. Anatomy is concerned with the far-reaching problems of heredity and the physical basis of inheritance, variation, constitution and the influences of environment. Experimental morphology has made rapid advances and is considered very important in checking against human material and human results. The live body and the human patient and the behavior of live cells, organs and systems in the living state and under different environmental conditions, and the interrelations of systems are all problems that concern the anatomist and the student of medicine. Although the dead body must still be used and for reasons that are obvious, one daily sees the importance of living anatomy as compared with cadaveric material.

The anatomico-physiologic and the anatomico-pathologic borderline fields are proving fruitful lines of investigation and application, as are the physical and chemical aspects of morphology. Thus, the experimental morphologist, in a study of the structural changes and reactions of living tissues incident to growth, development and environment, supplements pure morphologic procedures by the use of applicable physiologic, chemical, and physical methods in the solution of his problems. Few subjects, if any, are self-contained, and this integration of methods has proved a great factor in anatomical and morphological research. It is an illustration of effective coordination and correlation.

The undergraduate preparation for selected portions of this extensive program of anatomy in the medical curriculum comes to be highly important when one recalls, as stated elsewhere, that there are few branches in the entire medical curriculum in which the teaching and the comprehension of the subject matter do not require an understanding of the essentials of human anatomy, and in turn human anatomy cannot be promoted and correlated successfully without a mastery of basic and prerequisite studies.

After a sound general education, biology is the undergraduate field which has an outstanding and direct bearing on the preparation for the study of human anatomy in the medical school and to a lesser degree, chemistry and physics. Before one can discuss intelligently this phase of the problem, one must have an understanding of the meaning and scope of biology. Properly understood, biology covers a vast field of knowledge and has to do with all living things and living processes. Thus, biology embraces zoology, the science of all animal life; botany, the science of plants; and bacteriology, the science which deals with microscopic forms. Whether the latter are animal or plant or typically neither is still a mooted question. It is clear, since biology has to do with all the branches of study relating to animals, plants and ultra-cellular organisms, that the subject is too extensive for study without further subdivision, save in a very general manner. Zoology can be subdivided into morphology, physiology, cytology, histology, embryology, etc. Botany permits of a similar subdivision.

The fact that in some of the larger universities more than sixty courses of study are offered in the biological field is evidence that there must be a selection of subject matter from the larger field for the premedical curriculum. There is at the present time considerable difference in the biological training of prospective medical students in the several colleges and universities, that is, in scope, selection of courses, methods, and effectiveness in presentation and learning. In the early years of the medical course, this often leads to needless repetition of certain studies for some students and to too intensive and rapid pace for others. In the medical course, anatomy is often conducted in such a manner as to meet the needs of those students who have had the least preparation in subject matter, general discipline and technique. This means, as stated elsewhere, that for a goodly number of students there is a considerable amount of overlap and repetition. And the fact that the latter group may rank higher in grades does not necessarily mean that these students are the more capable and apt, for one must recall that they are doing the same work for the second time. For the poor student, such repetition may be a good thing, but the strong and well prepared student should be moving ahead in more advanced work.

The following would appear to fill the needs as prerequisite subjects in the biological field preliminary to the study of human anatomy in the medical school: Introductory general biology or introductory zoology, 6 credit hours; comparative anatomy and morphology of vertebrates, 6 credit hours; mammalian anatomy, 3 credit hours; vertebrate embryology, 5 credit hours; invertebrate zoology, 3 credit hours.

When general biology is selected as the only course of study and when

an effort is made to cover the entire field of all life, the work is apt to be too skimming in character and wanting in the required information and mental and technical discipline. If such a course is given, it should, perhaps, merely be considered in the sense of an introductory presentation. I realize fully that a course in introductory general biology may be given in such a manner that it fully satisfies the requirements.

In lieu of six credit hours in introductory biology or zoology, there are those who would give three hours to introductory zoology or vertebrate zoology and three hours to introductory botany. I have an open mind about this arrangement, however, I fear that it would not permit considering either of the subjects in a broad enough manner. It is to be regretted that a course in botany cannot be added to the premedical curriculum. Some colleges and universities do arrange for a three hour course.

The six credit hours course in comparative anatomy and morphology of vertebrates may include a satisfactory amount of mammalian anatomy. If so, the three credit hours course in mammalian anatomy can be omitted. That the latter should in some form be included in the undergraduate work cannot be gainsaid. I consider it very important.

I wish to urge that vertebrate embryology, say a four or five hours credit course, be made a requirement for admittance to medical colleges and schools. This course should be of such character that it could largely replace the course in embryology now given in medical schools. In the medical school it would, of course, still be necessary to consider certain phases of embryology peculiar to the study of medicine and its practice. The latter would, however, be made a much briefer course and would be presented to students all of whom have had a course in basic vertebrate embryology. Moreover, having in mind that now more than one-half of the students entering medical schools have had an acceptable course in vertebrate embryology, this arrangement would preclude the need of unnecessary repetition of subject matter, lighten the work of the first year in medicine, and result advantageously in other ways.

A premedical course in histological technique and the histology and histogenesis of the tissues would introduce the heavy course in medical histology in the first year of the medical course. I fear, however, that this would crowd out subjects in the premedical training which could not be taken after the student entered on the study of medicine. Not that histology is unimportant, but a large portion of the first year in medicine is given to the study of this branch. It might be possible to include a certain amount of technique and a consideration of the general features and use of the microscope in connection with one or other of the biological or zoological courses.

My feeling is that the study of bacteriology, so far as prospective medical students are concerned, can and should wait for the extended course in this subject in the medical school. It is there that the subject has its natural setting, coordination and application. As a rule, brief elementary courses in bacteriology, as part of the premedical training, are inadequate for medical needs and when other things are crowded out in the premedical program by such courses, the promotion of medical education is little served. Although a part of general biology, bacteriology merits separate and individual attention and does not require further consideration in the present connection. Psychology, too, strictly a part of general biology, is best handled as a separate subject. This is likewise true for physiology.

My experience leads me to believe that students should first pursue a fairly comprehensive general course in zoology rather than take abridged premedical courses in lesser phases of the subject which frequently serve little more than to give credit hours. It is not merely the acquirement of a number of isolated facts that is important, but the subjects prerequisite to the study of human anatomy should be considered in a broad manner, so that the learning in the fields of study may become orderly and moderately complete, as well as result in a great mental discipline and technical training. This, I believe, is best accomplished when selected premedical students master full and substantial divisions of study rather than in a kaleidoscopic manner take choppy and abbreviated parts of subjects.

Little wonder that there is lack of uniformity in the premedical training when one recalls that more than eight hundred colleges and universities are engaged in preparing students for the study of medicine. Just as the personnel, the methods of instruction, the equipment, etc., in the several departments of the same college or university differ, so the general conditions and atmosphere in the several colleges and universities, in which premedical education is conducted, doubtless differ even more widely. Courses and grades, therefore, do not always mean the same thing. It does not necessarily follow, since certain subjects are specifically required for admission to medical school, that there is an equality in the preparation of these subjects.

Although the undergraduate preparation for the study of medical anatomy is reasonably satisfactory, there is considerable imbalance at the present time. Undergraduate colleges and teachers will, I presume, continue to vary in the selection of biological subject matter preparatory to the study of human anatomy and will continue to stress different aspects of the work as well as differ considerably in end results. Lack of moderate uniformity in preparatory work unfortunately leads to certain difficulties and confusion in conducting the various courses in medical anatomy. More-

over, as stated elsewhere, courses must often be arranged to meet the needs of those students with the least preparation. This means a repetition of work for many students, on the one hand, and an extremely heavy load for those who have had little or no preparation in a given field, on the other hand. It is for this reason that I urge placing vertebrate embryology on the list of required subjects for entrance on the study of medicine.

CONCLUSION

In conclusion, I would again stress the importance of the student himself, having in mind aptitude, ability, interests and industry. Although some premedical courses are definitely prerequisite, it is often not so much what has been studied but how it has been studied and what mental discipline has come to the student through such studies and contacts that is important. My experience is that students who in their undergraduate work have been taught to be accurate and thorough and critical in their studies, observations, and laboratory techniques, moreover have developed the power of logical thought and the spirit of the investigator, get along best in the study of human anatomy as outlined in the modern medical curriculum. Students in their premedical work never should be permitted to do their laboratory assignments in a slovenly and indifferent manner. Practically never do such men excel in their medical studies.

Physiology and Premedical Training*

BRENTON R. LUTZ

Associate Professor of Physiology, Boston University School of Medicine
Boston, Massachusetts

The chief aims in examining the relation between physiology and premedical training may be stated as follows:

First, to find the relative importance of the premedical subjects for the study of physiology in the medical school.

Second, to test the results of premedical teaching in specific courses, as judged by the achievement in the first year of the medical school.

Third, to obtain further information concerning the value of premedical grades in specific courses as a means of predicting achievement in the first year of the medical school.

At the outset, it may be stated that while these problems are not solved completely in this study, the fallacy of expecting a high correlation between a specific premedical course and a certain first year medical course becomes apparent.

While considerable attention has been given to the combined premedical grades and medical achievement, the value of a consideration of the scholarship in individual premedical courses with a view of predicting possible success or failure in such first year medical courses as physiology, anatomy or biochemistry has been given little or no statistical attention.

Moursund[1], in considering premedical qualifications, stated, "A larger number of students made low grades, that is C or less, in English than in either of the sciences, while a larger number made C plus or better in biology than in either of the other courses."

Cramer[2] studied the records of 294 students in the Medical Schools of the University of Chicago and found a coefficient of correlation of 0.53 between medical grades and the total premedical work, 0.50 with the "biological sciences," 0.46 with the "physical sciences," and 0.38 with "subjects other than the natural sciences." He stated, "the grades made in the biological sciences alone are almost as good for predicting success

*Read at the Forty-sixth Annual Meeting of the Association of American Medical Colleges, held in Toronto, Oct. 28-30, 1935.

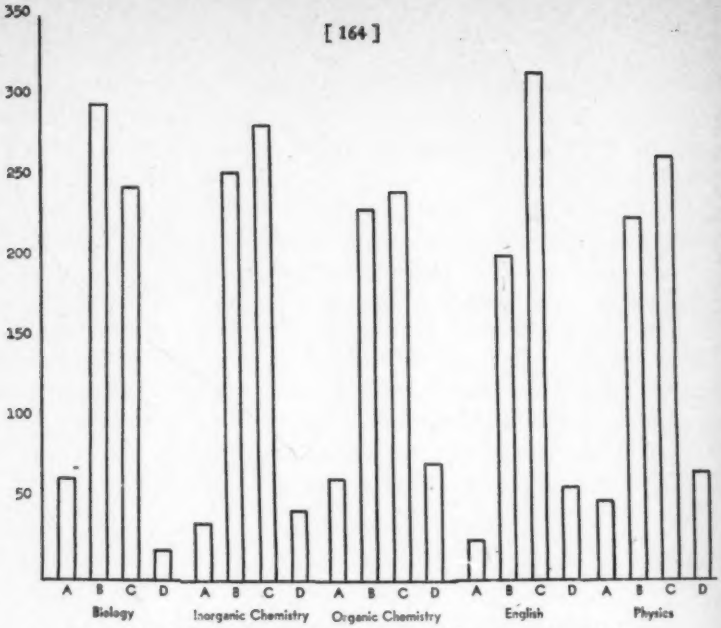

Fig. 1. Distribution by premedical grades in biology, inorganic chemistry, organic chemistry, English and physics.

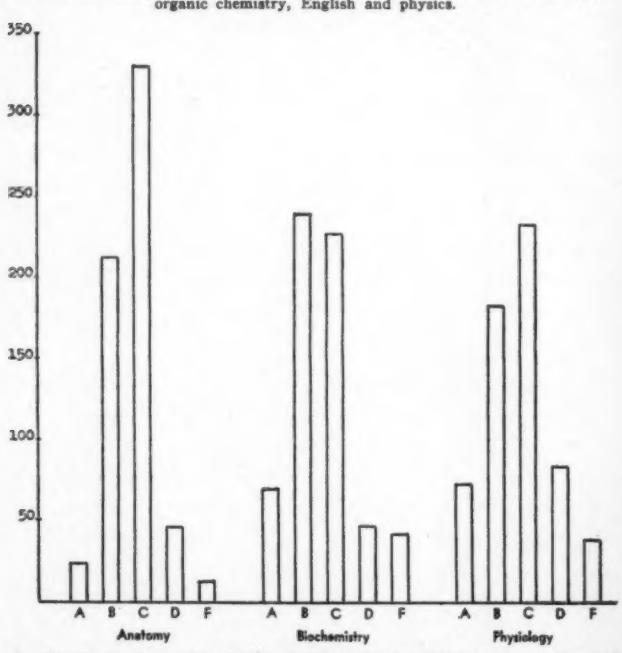

Fig. 2. Distribution by grades of same students after completing anatomy, biochemistry and physiology in medical school.

in the medical schools as are all the grades taken together." Although Moursund's report covers 962 admissions from 153 colleges, he gives no correlation coefficients between individual premedical courses and courses in the medical school.

Methods of improving our present means of selection of candidates for the medical school are admittedly desirable. Some investigators hope to find a single criterion, others take a broader and less optimistic view. Thus Moss,[8] discussing the medical aptitude test, said, "When all cases are considered, it is the best single criterion for success in the average medical school." Moursund, comparing premedical qualifications and medical school achievement stated, "It would seem that premedical scholarship is our best and safest guide to what the student will do in medicine." Thus, directly opposed views are held by well qualified observers.

In comparing physiology with premedical courses one must keep in mind that physiology is a hybrid. The factors concerned in its makeup are the basic sciences of biology, chemistry, physics and mathematics. These are a part of every premedical curriculum. Proficiency in these subjects, theoretically should be associated with high achievement in physiology, and greater efficiency in the training of the physician. The very complex nature of physiology, however, makes it difficult to compare with other fields of knowledge of more homogeneous content. Moreover, anatomy, histology and biochemistry are studied in the medical school either before or concurrently with physiology.

SOURCE OF DATA

With the foregoing considerations in mind, the present study was made of the grades of more than 600 first year medical students at Boston University School of Medicine for the decade 1925 to 1935. These students were admitted from 100 premedical colleges. The minimum requirements for admission are 90 semester hours and a C average. The grades in biology (biological sciences), inorganic chemistry, organic chemistry, physics and English were taken from the files of the registrar. The dean's files were used for the grades in physiology, anatomy and biochemistry. No important changes in the personnel of the first year instructing staff has been made during the period studied, and, therefore, the grading may be considered to be fairly uniform.

Since the standards of grading in different premedical institutions must vary greatly, the grades of 120 students taking their premedical work at Boston University College of Liberal Arts were considered separately as

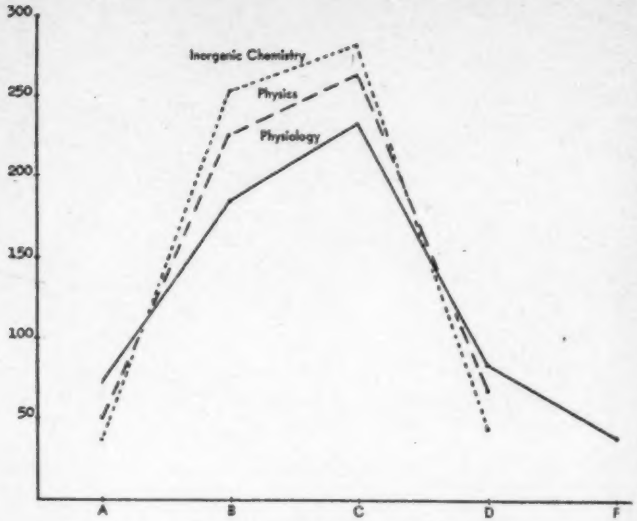

Fig. 3. Comparative frequency polygons of physiology with physics and inorganic chemistry.

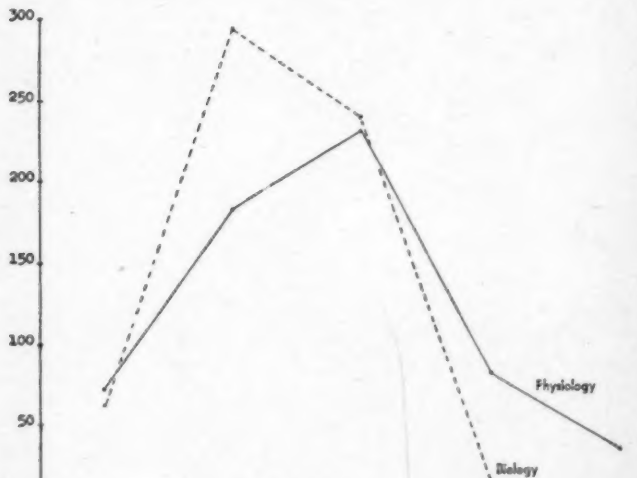

Fig. 4. Comparative frequency polygons of physiology with biology.

well, although included in the larger group. This comparison was expected to be useful in judging the premedical training in our college.

For the calculation of all coefficients of correlation the short method was used, and plus and minus grades were taken into account making twelve classes listed against ten in the correlation tables.

RESULTS

The distribution by premedical grades of the candidates admitted is shown in Figure 1 for biology, inorganic chemistry, organic chemistry, physics and English. Here it is interesting to note the large number having B in biology, the more equal distribution of B and C in chemistry, the large number having C in English, and the relatively large number having D in organic chemistry, physics and English.

The distribution by grades of the same students after completing the first year of medicine is shown in Figure 2 for anatomy, biochemistry and physiology. In anatomy, a small number got A and a large number got C. About equal numbers got B and C in biochemistry, while there was a greater spread of grades in physiology.

Interesting, although possibly misleading, are the comparative frequency polygons of physiology with physics and inorganic chemistry in Figure 3, physiology with biology in Figure 4, anatomy with English in Figure 5, and biochemistry with organic chemistry in Figure 6. While it is recognized that such comparisons are of limited value, it is interesting to note the similarity in Figure 5 and also in Figure 6, especially since very low coefficients of correlation were found in these pairs.

The coefficient of correlation for physiology with biology in all colleges is 0.34 $\pm$.024, (Figure 7), and for physiology with biology at Boston University 0.48 $\pm$.048 (Figure 8). The correlation of physiology with physics in all colleges is 0.30 $\pm$.025, and with physics at Boston University 0.49 $\pm$.046. For physiology with inorganic chemistry in all colleges the correlation is 0.23 $\pm$.026, with organic chemistry in all colleges .25 $\pm$.025 and with English in all colleges 0.15 $\pm$.026 (Figure 9).

The correlation of anatomy with biology in all colleges is 0.26 $\pm$.025; with biology at Boston University it is 0.43 $\pm$.050. Anatomy with English in all colleges gives a correlation of 0.14 $\pm$.026.

The correlation of biochemistry with organic chemistry in all colleges is 0.22 $\pm$.026 (Figure 10); with organic chemistry in Boston University it is 0.20 $\pm$.059.

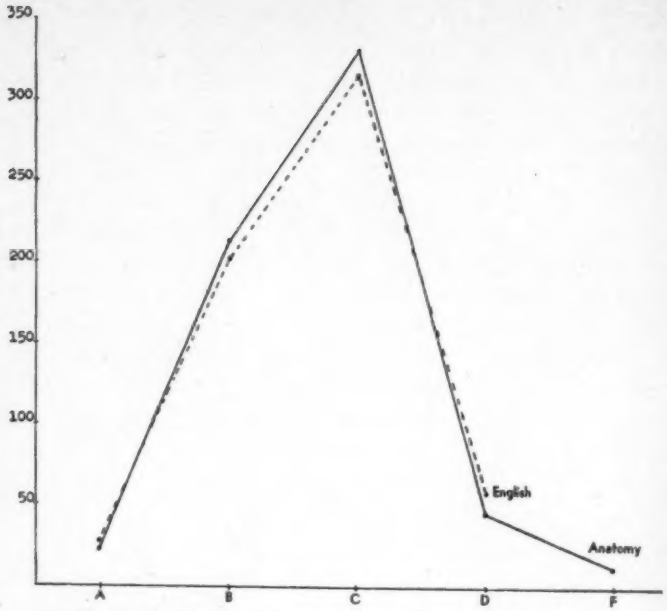

Fig. 5. Comparative frequency polygons of anatomy with English.

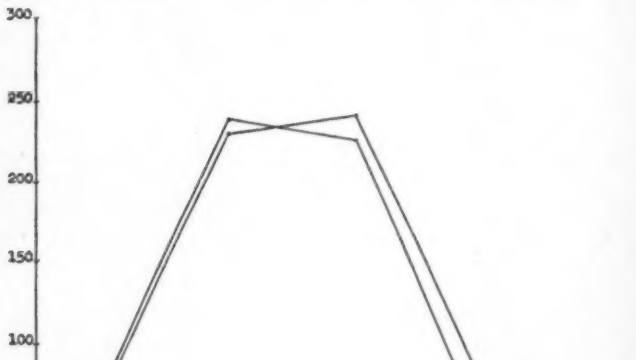

Fig. 6. Comparative frequency polygons of biochemistry with organic chemistry.

DISCUSSION

For physiology, the highest correlations are with biology and physics in a limited group of students in a single college. All the correlations of physiology with the various premedical subjects are low when all colleges are considered. The highest is with biology (0.34) and the next highest is with physics (0.30). These figures are considerably lower than those given in the literature for the average college grades and the whole medical program; for example, Moss[3] 0.50, and Cramer[2] 0.53. They are also lower than Moon's[4] correlations of 0.57 between laboratory science and the average grade of the first year of medicine, and figures of around 0.40 for each separate subject compared with the first year of medicine.

The reasons for the low correlations found in the present study are obscure. High mathematical correlation can be expected only under the following conditions. First, when the subjects have some similiarity in content or method; second, when the ability of the student in the two subjects is the same and he applies himself equally in each; and third, when the grades represent fairly the achievement or ability in the subjects correlated. The widely varying standards of premedical instructors and the variations in application on the part of the student in different courses make for lower correlation. The same factors make the use of correlation somewhat uncertain in judging the results of premedical training, but when applied to students and courses within a single university it gives instructive data.

Another factor influencing correlation is the standard of admission in the medical school, as pointed by Moon,[4] who stated, "Ordinarily the higher the standard of admission the lower the correlation." When the standard is high enough to exclude all candidates of mediocre ability and poor training, low grades in medical school are more likely to be due to chance factors of application. Scholastic ability would not be an important factor in determining the degree of correlation, and thus low figures might be expected.

The correlation of physiology with English, namely 0.15, and of anatomy with English, namely 0.14 is to be expected, but the correlation of biochemistry with organic chemistry, namely 0.22 in the large group and 0.20 in the selected group is a surprise. The content of the two latter courses is similar, and the standard of admission for organic chemistry is not high as seen by the relatively large number of "D" students in that

PHYSIOLOGY $r = .34 \pm .024$

BIOLOGY	A 5	A- 4	B+ 3	B 2	B- 1	C+ 0	C -1	C- -2	D+ -3	D -4	D- -5	F -6	
A 5	4	4	3	4	1	2	4	1		1		1	25
A-4	2	7	4	9	3	1	4	6		1			37
B+3	3	6	6	9	9	4	10	2	2	4		2	57
B 2	8	15	18	17	20	15	25	10	5	7	1	7	148
B-1	2	8	7	8	6	7	15	12	5	6		1	77
C+0	3	5	5	12	12	8	14	14	3	12	5	7	100
C -1	1	5	2	9	11	20	19	16	4	8	4	10	109
C- -2		1	1	2	4	1	2	4	3	5	1	6	30
D+ -3					1	2		3	1	2	1	1	11
D -4							4	1	1			2	8
	23	51	46	70	67	60	97	69	24	46	12	37	602

Fig. 7. Correlation for physiology with biology in all colleges.

PHYSIOLOGY $r = .48 \pm .045$

BIOLOGY	A 5	A- 4	B+ 3	B 2	B- 1	C+ 0	C -1	C- -2	D+ -3	D -4	D- -5	F -6	
A 5	1	4	1	2									8
A-4	2	2	1	4	3	1	1	3					17
B+3	2	2	3	5	5	1	2						20
B 2	1	4	4	7	8	5	7	1					37
B-1		1	1	1	4	2	4		2	1			16
C+0		1		2		1	2	4		1		2	13
C -1				1			1	2		1			5
C- -2		1								1			2
D+ -3													
D -4													
	6	15	10	22	20	10	17	10	2	4		2	118

Fig. 8. Correlation for physiology with biology at Boston University

PHYSIOLOGY $r = .15 \pm .026$

ENGLISH

	A 5	A- 4	B+ 3	B 2	B- 1	C+ 0	C -1	C- -2	D+ -3	D -4	D- -5	F -6	
A 5	1	2	1	1	1	2	2	1					11
A-4	2	2		4	2		1	1		1		1	14
B+3	1	4	7	2	4	1	4	6	1	2	1	1	34
B 2	7	14	4	15	13	11	21	10	3	7	3	7	115
B-1	2	8	3	7	6	8	16	7	1	5		1	64
C+0	2	5	13	4	7	11	16	9	1	8	1	6	83
C -1	7	11	7	19	18	17	28	21	11	14	4	10	167
C--2	2	2	3	6	6	5	7	4	7	4	1	7	54
D+-3		1	4	3	5	2	7	6		1	2	3	34
D -4			2	1	6	2	5	3		2		1	22
	24	59	44	62	68	59	107	68	24	44	12	39	608

Fig. 9. Correlation for physiology with English in all colleges.

BIOCHEMISTRY $r = .22 \pm .026$

ORGANIC CHEMISTRY

	A 5	A- 4	B+ 3	B 2	B- 1	C+ 0	C -1	C- -2	D+ -3	D -4	D- -5	F -6	
A 5	8	8	4	9	4	7	6						46
A-4	2	3		2	4	3	1					2	17
B+3	2	4	8	4	4	5	3	2	1				33
B 2	9	8	10	28	17	22	18	15	6	1	1	17	152
B-1	2	4	5	9	5	10	4		1	3	3	1	47
C+0	2	4	3	10	5	8	8	3		1		1	45
C -1	5	6	8	24	27	18	26	11	10	6	2	18	161
C--2	2	1	1	2	6	9	6	6	3	2		3	41
D+-3			2	4	4	1	7	2	2	1		2	25
D -4		1	2	8	7	6	14	5	3	1		2	49
	32	39	43	100	83	89	93	44	26	15	6	46	616

Fig. 10. Correlation of biochemistry with organic chemistry in all colleges.

subject accepted for entrance. Therefore, premedical standards of grading and variations in application on the part of the student may be responsible for these low correlations.

One may conclude that proficiency in premedical courses, especially in biology and physics is more useful in the medical course in physiology than the low correlations would imply. High correlations are not to be expected in view of the practical conditions of premedical training.

SUMMARY

1. The coefficient of correlation between the grades in the medical course in physiology and the premedical grades in biology in 602 unselected cases is 0.34, with physics 0.30, with inorganic chemistry 0.23, with organic chemistry 0.25 and with English 0.15.

2. The correlation between the grades in the medical course in physiology and the premedical grades in the biology of 118 students at Boston University, College of Liberal Arts, is 0.48; with physics it is 0.49.

3. The correlation between grades in first year gross anatomy and the premedical grades in biology in 619 cases is 0.26; with English it is 0.14; and with the biology of 118 Boston University students in the College of Liberal Arts it is 0.43.

4. The correlation of biochemistry and organic chemistry in 616 cases is 0.22, and in 120 cases from Boston University, College of Liberal Arts, it is 0.20.

5. The low correlations found in this study are believed to be determined by the practical conditions under which both medical and premedical courses are taken rather than by the ability of the student.

FOOTNOTES

1. "Premedical Qualifications in Relation to Achievement in Medical School." Walter H. Moursund, *J. Assoc. Amer. Med. Colls.*, 1932, 7, 149.

2. "A Study of the Selective Admission of Students in the Medical Schools of the University of Chicago." W. F. Cramer, *J. Assoc. Amer. Med. Colls.*, 1933, 8, 347.

3. "Report of the Committee on Aptitude Tests for Medical Students." F. A. Moss, *J. Assoc. Amer. Med. Colls.*, 1932, 7, 129.

4. "Relation of Certain Factors in the Student's Premedical Record to Success in Medical School." George R. Moon, *J. Assoc. Amer. Med. Colls.*, 1934, 9, 267.

The Physical Sciences in the Training of the Physician*

R. K. CANNAN
Professor of Chemistry, New York University College of Medicine
New York City

When the printed program of this Symposium came into my hands, I was chagrined to observe that my choice of title departed from the careful design of the discussion. It was, clearly, intended that my voice should be the voice of biochemistry. It was intended that I should discuss such aspects of premedical education as touch most nearly on the teaching problems of a department of biochemistry within a medical school. At the time I was required to submit my title, however, I happened to be a little unhappy about biochemistry. By this I mean that I was dissatisfied with its present position in the medical curriculum. That it has fully justified itself as a distinct field of organized knowledge and research is not in dispute. He who runs may read. But this success does not necessarily confer on it the right to independent status in the education of the physician. We are, one may suppose, agreed that a well conceived medical curriculum should be one coherent whole. Its object is to provide sound foundations for and, then, a comprehensive introduction to a broad experience in clinical medicine. Its object is not achieved merely by submitting a student to a logical succession of independent disciplines. Departments are necessary and courses are necessary in organized medical instruction, but it is of first importance that these be so designed as to minimize rather than to magnify departmentalism of knowledge in the mind of the student. It would seem that individual departments may be justified only in so far as each makes to the curriculum some unique contribution not within the province of another.

In the case of biochemistry, this distinctive contribution was not immediately obvious. I did not find it in conventional curricula of the subject. I did not find it in the standard textbooks which have been prepared for the use of medical schools. I found, rather, that biochemistry occupied an ill-defined territory between the physical and medical sciences. It would appear, that, by a process of peaceful penetration, biochemists had established spheres of influence within the proper boundaries of premedical curricula on the one hand and of the fundamental sciences of medicine, particularly physiology, on the other. The disturbing thing was that these acquisitions did not appear to have been dictated by any clear policy. Like Topsy, it would seem, we "jest growed."

*Read at the Forty-sixth Annual Meeting of the Association of American Medical Colleges, held in Toronto, Oct. 28-30, 1935.

In my dilemma as a teacher dissatisfied with his allotted task, I turned to the consideration of the relations between premedical and medical curricula. I found that between them there is a great gulf fixed. Students have a very real difficulty in reorienting themselves in the atmosphere of the medical school. This fact is so continually affirmed both by teachers and by students that there can be no doubt of its existence. The difficulty does not lie in a quantitative difference in standards of scholarship but, rather, in the more elusive qualitative forms of intelligence. Its roots are to be sought in the radical difference of outlook of pure and of applied physical science. Because I am persuaded that the resolution of these divergent views is the mutual problem of instructors in biochemistry and of teachers of the physical sciences that I invite your consideration in greater detail.

The student of inanimate nature has the privilege, in large measure, of posing his own problems. He is free to pursue his science down such narrow avenues as available techniques make most profitable. He may select his own variables. Quite logically, he prefers to limit these experimentally so that the relationships at which he arrives may have the greater precision and certainty. This inevitably leads to intensive advances in narrow compartments of knowledge. It leads to the history of progress being written in well defined chapters each of which is elegantly self-contained, though not always well articulated with the others. Indeed, the specialist often invents his own language based on local conventions,—a language which cannot be translated profitably into that of other chapters of physical science. These convenient subdivisions become the conventional bases of instruction in places where they teach physical science. So it is that we have the multitude of special courses which adorn the pages of the bulletins of every self-respecting college. I do not for a moment affirm that the pure scientist is indifferent to the relation of his particular chapter to a general philosophy of nature. But he knows that to demonstrate this he must sacrifice some of the elegance and precision of his own achievements and some of his own cherished language. He is inclined to leave the student very much to himself in this matter. The result is that the student is confirmed in the view that in physical science the military principle of engaging your enemy "in detail" is sound and profitable tactics. He does ultimately achieve a synthesis of his knowledge into a broad "whole" but, in my experience, this comes to him only when his studies are far advanced. It seldom comes at the stage at which the medical student deserts pure science for applied science.

The student of medicine, therefore, approaches the study of the medical sciences with a knowledge of physical science neatly pigeon-holed in the

classical tradition. He finds that the physiologist is impatient of these conventional distinctions. The physiologist talks of energy and of matter in the same breath. He asks physical questions about organic molecules. The student is disturbed. He feels that it is not quite "cricket" to play fast and loose with the conventions. Only slowly does he learn that in applied science you may no longer choose your own problems. They come ready-made. Your variables are chosen for you. Your system is already completely organized, for you are dealing with an organism. Nor may very much be done in the way of restricting variables by the device of "a first approximation." It is an axiom of biology, our student finds, that the organism is so finely integrated a physico-chemical system that it is seldom possible to touch one variable without passing the echo of that change over the whole pattern of matter and energy which is represented by the organism. And finally he learns that applied science is not so much a question of dogma as a procession of problems to be solved.

This is, perhaps, the crux of the whole matter, for this is the basis on which we must persuade the student to approach the study of clinical medicine. Each patient is an individual problem demanding an individual solution. This must be drawn from the sum total of the physician's experience and there can be no nice distinctions as to the categories of experience which may appear formally to be significant to the problem.

One of the most frequent complaints of medical schools is that the students, whom they have selected on the basis of good scholarship, are found to lack maturity and intellectual self-confidence. They shirk problems. They appear to have little faith in the usefulness of their knowledge and experience. Paradoxically, when it is a matter of discussion rather than of action, none are so vehemently dogmatic as they. This complaint is too constant to be ignored. It is reiterated in almost every volume of the JOURNAL of this Association. In large measure, it is but the perennial lament of man at the inherent slothfulness of his mind. In some degree, however, it is probably a legitimate criticism of prevalent methods of education. We, who teach, must therefore satisfy ourselves that our methods are not such as to confirm the student in his little faith.

It is difficult to discuss problems of education without that self-consciousness which arises from a knowledge that one is repeating platitudes. What I have said, has been said before and needs must be said again. It will be so, as long as teaching practice continues to fall so far short of its principles. In respect of the teaching of the physical sciences, my thesis may be put quite briefly. We have permitted the intensive specialization of scientific progress to impose itself on our methods of instruction in

the elements of a general philosophy of inanimate nature. The student has no sure foundations for a tremendous superstructure of specialized compartments of factual knowledge. Moreover, our instruction has been didactic rather than problematic.

To revive the term "natural philosophy" is, I know, very rash. It smacks of metaphysical speculation. It suggests a diffuse dialectical kind of science. This we do not seek, but rather a rigid discipline in the manipulation of "stubborn and irreducible facts." It is not claimed that a discipline in what we are accustomed to call the scientific method is the peculiar province of physical, or indeed, of any science. We must acknowledge with G. N. Lewis that the scientific method "is hardly more than the native method of solving problems, a little clarified from prejudice and a little cultivated by training." Physical science does, however, make a rather precious contribution to an experience in applied common sense because of its objectiveness and its precision. Its facts are stubborn and irreducible and, withal, they can be stated in the form of numbers. Its problems are quantitative. To them there is only one answer which is the correct answer. There is no room for debate, no escape for the intellectual shirker. It is often objected that the use of mathematics in the training of the physician should not be emphasized since mathematics makes no significant contribution to successful clinical practice. The objection would be valid only if we made of the student mathematical demands much beyond those required of any man of affairs. Elementary physical science expects a facility in the application of the laws of proportion and a certain freedom in the use of a table of logarithms. Is this too onerous a burden? The student who shirks these may be expected to shirk the harder disciplines of medical practice.

I could be content to leave my thesis in these vague forms but the penalty of criticizing curricula is the obligation to submit alternatives. This I do with great temerity. It can be done properly only by those with a full experience of undergraduate instruction. I will, however, make some attempt to indicate what is in my mind when I speak of a progressive comprehensive curriculum in physical science for premedical students.

The student will begin, simultaneously, a study of the physics and chemistry of commonplace things. His physical approach will be through the mechanics of movement of familiar bodies so that he attains a certain facility in the translation of such common abstractions as force, pressure, kinetic and potential energy, work, equilibrium, velocity and so on. This is elaborated by an elementary treatment of the manifestations of radiant energy in its varied forms. His chemical approach will be through a relatively few simple chemical changes leading to the laws of chemical com-

bination, the atomic and molecular structure of matter and the electrical nature of atoms. At this stage, a definite detailed attempt will be made at a broad synthesis of the principles of physics and chemistry. It may be done by the logical extension of mechanics to define the behavior of molecular assemblies. In some manner, the principle of the second law of thermodynamics will have to be introduced. Perhaps, this might best be done with the aid of the probability integral. This has the merit of an air of familiarity and at the same time permits a mechanical method of description to be maintained. There will follow a simple picture of the states of matter, the laws governing changes of state and equilibria and also the laws of reaction velocity and equilibria in relation to energy magnitudes. The student will then return to distinctly physical and chemical disciplines directed toward widening his experience and supplementing his factual knowledge in these two fields. Finally, toward the conclusion of the curriculum, another sustained attempt at a broad synthesis of his knowledge will be made in such a way as to refine the general principles at which he has arrived and to define their present limitations. Such a curriculum will not distinguish rigidly between inorganic and organic chemistry. It will not treat physical chemistry as a special subject, nor yet any of the usual subdivisions of physics. Qualitative and quantitative analysis will not be taught for their own sake but will take their place in the general laboratory experience which will be a continuing auxiliary to the whole course, illustrating techniques, instilling precision, posing problems. In conference, I reject the term "recitation" with its perverse implication, the student will be consistently disciplined in the qualitative and quantitative analysis of situations. He will, on the other hand, be submitted to formal examination only at rather rare intervals. Such examinations will be searching and comprehensive calling on the sum of his experience to date.

The main purpose of all instruction shall be, by the cumulative power of a consistently developing argument, to animate the student with an active faith in the reasonableness of nature, and to give him confidence in his own power to discriminate variables and to control them. He will be persuaded to reject rule of thumb methods not merely because they have no basis in reason but because they are dull.

An important element in this hypothetical curriculum is that it be diffused over the whole period of undergraduate instruction. It is common practice at present for premedical students to acquire credits in all the fundamental science courses as early as possible in their college work. There follows a period occupied either with a carelessly assembled group

of courses in the humanities or with work which quite unnecessarily anticipates certain of the courses of the medical curriculum. It is usual, for example, for the student to complete his formal studies in physics in the sophomore year. He does not again encounter problems involving physical principles until, perhaps three years later, he is suddenly confronted with the mechanics of muscle, the dynamics of circulation, the principles of radiation therapy and so on.

Is it possible to incorporate a curriculum after this pattern within the framework of premedical education? Would it require the sacrifice of time which at present is, very properly, devoted to studies in the humanities? It is not so intended. The demand is not for an increase in the time devoted to physical science but for a rationalization of the curriculum. Indeed, it would seem that it is only by such means that the liberal arts colleges will be able to meet the continual advance in the standards of professional requirements without granting more and more concessions in preprofessional subjects.

That the colleges are sympathetic to a change, there can be little doubt. They are actively critical of their own curricula. There is increasing impatience with departmental autonomy in undergraduate instruction and a tendency to revert to organized progressive curricula in human thought and achievement. In such curricula there is small place for physical science that is taught according to present conventions. The scientist may, however, hope for a proper recognition of his contribution to contemporary civilization when he can show that his instruction is, in truth, a broad discipline in the scientific method—common sense at work on material things.

I would not close my contribution to this discussion without a final confession of faith. As each year is added to my experience as a teacher, I become the more convinced that it is the personal factor in education which counts. Teaching is a cooperative enterprise. It is a "gentleman's agreement" between the individual student and the individual instructor. Given this, the forms of instruction and the substance of instruction assume only secondary importance. Each year our classes divide themselves into the good, the bad and the large group of rather inarticulate mediocrity. We take pains, to be sure, that none of the bad shall slip through our machinery of selection. We hope that one or two of the middle group may raise themselves, through the power of our enthusiasm and guidance, to take their place with the honor men. In respect of the latter, we can only pray that the defects in our instruction shall not be so great as to weaken their faith or offend their reason.

DISCUSSION

ON PAPERS OF DRS. SCHNEIDER, HOLMES, SMITH, SCHAEFFER, LUTZ AND CANNAN

DR. BEVERLY DOUGLAS (Vanderbilt University): It has been our experience at Vanderbilt over a period of several years that many of the students who enter medical school have a training in physical chemistry which is inadequate to their proper comprehension of the material presented in biochemistry. This certainly is a very grave problem, not only for Vanderbilt but for many other institutions. Frequently, in the premedical course sufficient training is not given to enable men to understand the course in biochemistry. What is to be done about it?

I do not wish to be so specific as to say that the requirements should include courses in physical chemistry or college algebra. I realize that some schools require only two years of premedical training, and that they cannot insist that physical chemistry be a required subject. On the other hand, after these splendid papers we have heard this morning, which indicate how integrations may be brought about between the different subjects, it seems to me that less time might, perhaps, be devoted to other branches of chemistry and a little more stress be put on physical chemistry.

Of course, the better students in the premedical course might get the training they need by being advised to take certain courses outside of their curriculum at various times,—maybe in the summer; but this, after all, is an irregular and artificial process. Furthermore, in certain cases we have found that the premedical instructor will not advise students to take such courses as physical chemistry, trigonometry or college algebra. Dr. C. S. Robinson has recently related a specific instance in a neighboring state where men had been advised against taking such courses.

On the other hand, we view with considerable satisfaction the increase in the number of small colleges which are giving courses in physical chemistry. Recently, Dr. Robinson had occasion to look up this subject, and he found that in and around Tennessee ten schools and colleges, the enrollment in which on the average amounted to 548 students, including the summer students (figures included to give an idea of their small size), were giving courses in physical chemistry. These colleges were small. Only one-half of them are accredited by our Association, the other half being accredited only locally or by the Southern Association.

To summarize, then, it seems to me that as long as we have a minimum requirement of two years of premedical training, the medical school cannot insist on courses being given or being required in such courses as physical chemistry. Nevertheless, it is to be hoped that in the near future even in the two-year premedical course the physical and quantitative sides of chemistry may be duly emphasized. Frank discussions of the problem by both premedical and medical men such as we have had here this morning should certainly accomplish this end.

MR. W. C. MACTAVISH (New York University): I fear that what has been said this morning is a rather severe indictment of the teaching in premedical courses in colleges throughout the country, but we are rather inclined to lose sight of the practical aspects of this part of undergraduate work.

Most students of medicine have completed three or four years of undergraduate work. If we accomplish so little in this period of time, what is to be said of the training of students,—about 20 per cent—, admitted to the medical schools after only two years of premedical study?

For some time there has been a feeling of resentment on the part of undergraduate teachers and administrators of the medical colleges' control of the undergraduate curriculum. For a while students were electing about three-quarters of their undergraduate work in sciences. At our school, we passed a rule in 1926 requiring college medical students to take one-half of their undergraduate work in non-science subjects. Even so, a student could take forty-eight semester hours in science in three years yet how he could complete all the courses stated as desirable or recommended this morning is very difficult to see.

As far as the integration of the work is concerned, I believe that the physical and other aspects of the subject are usually emphasized by chemistry teachers. The same thing is true in the teaching of physics as related to chemistry or biology. It seems we are not very successful, from what Dr. Cannan and others have said. We do try to integrate the various sciences but with so much fundamental material that must be taught in beginning courses a certain amount of the integration must be left to the medical school teachers.

A practical difficulty that must be considered is the great number of semester hours which would be necessary to cover the required and all of the recommended courses. It has been suggested that students take history, mathematics, physics, a large amount of chemistry and biology, logic, Greek, and so on. If all these courses were taken, the premedical course would have to be extended considerably. Most of the arts colleges which have liberalized their curriculum no longer require the students to take Latin or Greek. I advise our students to complete the minimum requirements in physics, chemistry and biology, and fill out their curriculum with electives in the cultural courses. It will be difficult to continue this practice after what has been recommended this morning by some of the speakers. Professor Holmes, for instance, prescribed practically four years of chemistry.

On the other hand, we have to combat the tendency of students to take an excessive amount of science as their friends already in medical school advise them to do. The friends write, "By all means take physical chemistry, because you will have an awfully hard time in such-and-such a medical school if you don't;"—in another school, where the biology requirement is high,—embryology, genetics and physiology. It is a very difficult task for us to control the students and keep them within the limits of a reasonable science program and to leave time to take the necessary cultural work.

Dr. C. C. Macklin (University of Western Ontario): As one interested in the teaching of the anatomical sciences, I have found two of the papers particularly arresting,—those of Drs. Schneider and Schaeffer. Both men emphasized the importance of heredity in medical education.

To my mind, the science of genetics has made greater advances in recent years than any of the other branches of biology. It is at the very center of the biological stage. If the biologist teaches adequately the facts and principles of modern genetics to beginning medical students, it will be easy for those in the

medical school who are concerned with the teaching of inheritance of diseases and abnormalities to carry on the good work. More and more medical teachers are becoming convinced of the indispensability of a thorough training in normal and pathological human heredity; and the formulation and establishment of definite courses in this science is going on apace.

Dr. Schaeffer recommended that embryology be taught as a premedical subject. In my experience, the successful presentation of the later aspects of embryology demand some antecedent knowledge of the structures whose development is being discussed. We find it desirable to introduce the embryological course after dissection has become well advanced. The student has difficulty in grasping the development of such complicated formations as the lesser peritoneal sac and its adnexa if he has not seen and handled the parts implicated. How can he understand the descent of the testis if he has not examined the inguinal canal? It is possible that a short preliminary course in embryology might be given successfully; but in addition the more difficult points of later development of the organs and parts should be elucidated during or following the dissection work. We find it preferable not to break the continuity of the embryological course, and feel that it can best be shaped to medical ends by placing it toward the end of the dissection course. I understand that, in Dr. Schaeffer's scheme, he, too, would give embryological interpretations during his anatomical course. The importance of embryology in medical education can hardly be over-emphasized.

Professor Edward C. Schneider (Wesleyan University): One of your problems is that of selection. I have had abundant experience with well trained linguists, particularly some trained in Latin, and have found that while they may handle their Latin very well and read it well, the application to the derivation of scientific terms is often a blank in their minds.

If you could succeed in evolving a plan of selection that would reveal those men who have the ability to apply the facts and principles that have been taught them, then your problem would be solved. I do not know what that scheme of selection is, but I believe that we in biology, and I can say that we in chemistry, because I have been trained as much in chemistry as I have in biology, try hard to help you by the letters we write concerning applicants. Often it seems to us that our letters are ignored or discounted. When I write my letters regarding men, I try to discriminate and indicate whether I think they are mentally alert. Maybe you had better try, among those of us who are working in the premedical field, to get us to say whether we think we are dealing with an active mind or whether we are just dealing with a sponge.

Dr. J. Parsons Schaeffer (Jefferson Medical College): Although I listed a number of subjects in my paper which I believe desirable in the premedical course, I also stated that so far as some of the languages are concerned and probably certain other courses the work and ground covered in the secondary school might, perhaps, be considerable ample. There is no reason at all why, for example, three or four years of Latin in a good preparatory school should not be adequate. If we could look to the preparatory schools for part of the language training, some of our difficulties of a crowded premedical program would be correspondingly lessened. When three or four years are given to the premedical program, many

of the difficulties are overcome. The crowding and the selection of courses in a two-year premedical course presents grave problems.

Finally, if the undergraduate or premedical work has created in the student the spirit of the investigator and the spirit of doing for one's-self, I believe that the premedical preparation has accomplished the greatest single good.

DR. BRENTON R. LUTZ (Boston University): From my studies I am beginning to lose my faith in grades. I am associated with both premedical work and medical work, and so particularly, that correlation between organic chemistry and biochemistry seems to worry me. I wonder if there is anyone here who can offer an explanation.

DR. R. K. CANNAN (New York University): An appeal has been made that a course in physical chemistry be a prerequisite for admission to medical school. This would, I think, be most unfortunate. I agree that the physical aspects of biochemistry are those which the medical student finds most difficult. The kind of physical chemistry, however, which he needs as a foundation for the medical curriculum is fundamental theoretical chemistry and, to my mind, requires no other label. Let a general course in chemistry be founded on some understanding of the relations of matter and energy. Let this be applied to molecular assemblies leading to the consideration of the principles which govern physical and chemical changes—rates of change and equilibria, changes of state, the behaviour of solutes and of ions and the applications of the mass law. Given such a foundation, the demand for a special course in physical chemistry would lose its force. At the same time, we would have minimized rather than magnified, in the mind of the student, the arbitrary divisions of physical science.

DR. WILLIAM A. PERLZWEIG (Duke University): I am teaching biochemistry, and I am also what you might call a clinical biochemist. That is, I have worked in medical clinics for many years and, presumably, I am acquainted with medical problems at first hand.

I came here with an ax to grind, but some of the grinding has already been done by some of the previous speakers, particularly by Dr. Cannan, who covered almost verbatim all of the thoughts I had in mind. I have not seen Dr. Cannan, and we have not discussed the problem together. I feel so strongly about it, however, that I think it would be worth while to reiterate some of the basic ideas Dr. Cannan has expressed this morning.

I have been impressed, year in and year out, in facing first year medical students and interns, with the fact that the premedical educational system, particularly in the teaching of the preclinical sciences, fails in one of its most important phases. It fails to develop the attitude that we expect of the medical student and the medical practitioner, the habit and ability to think in terms of those sciences whose rudiments he is supposed to have acquired in his premedical course.

The first year student still appears in our medical school and asks me in the first or second week of the course, "Doctor, what chapter am I to prepare for tomorrow's recitation?" Still more concretely, when I come to the medical student in the laboratory and ask him why he is doing this particular experiment, why he is playing around with silly test tubes, he first looks at me rather bewildered

as though I were a blithering idiot, and finally says in great confusion, "It is assigned for today." At first one is tempted to laugh at this answer, but it is really more a matter for grieving.

Then I ask him: "If left to yourself, would you do this experiment? Have you any real interest in it? Would you do anything at all about it?"

His reply it: "Doctor, I have never thought about this. I have never been asked this question before."

I say to him then, "It would be worth your while to leave the laboratory and go and sit down in a comfortable corner and think out this particular problem; whether this experiment means anything at all to you; whether it is relevant to your education, to your purposes, or to whatever you wish to achieve in life."

One of them came back to me the next day and said, "I couldn't sleep because of your question. It was terribly upsetting." He had never faced that problem before. He had been taking his assignments on faith. He had to pass them off and present them for credit, and go on to other things. He regards his biology, physics and chemistry in college as a disease, such as measles, which must be taken for a certain number of semester hours and be done with in order to get into medical school. He must pass off his anatomy in medical school and proceed to the next subject. As he progresses in the medical school, he becomes aware of the fact that in order to deal with and treat disease intelligently he must understand its etiology and symptoms in terms of a successful synthesis of everything he had learned before. But has he been trained in the preceding years before he gets to the bedside in the processes and in the technique of such synthesis and integration of his knowledge? Is it not largely true, on the contrary, that in the fully eight years of his previous schooling much more emphasis had been placed on stuffing the poor student's mind with isolated facts, and more facts, without any attempt on the part of his teachers to orient him in this maze of facts, to teach him to organize them into that usable body of knowledge the possession of which distinguishes the truly educated man from his fellows?

It is true that of late years, under the pressure of the development of scientific medicine, there has been a greater effort made to correlate the preclinical and the clinical sciences, but should we not, as Dr. Cannan suggests, bring in a greater coherence into our premedical curriculum, if medical education itself is to achieve anything worth achieving? That is, to give the students a scientific approach to the problems of disease and of the prevention of disease.

I came here prepared to present the thesis that in the premedical curriculum we should not insist on three or four years of chemistry, or on this or the other additional course in chemistry, biology or in physics. We should rather insist on a continuous, coordinated, coherent course in the sciences, in which the student is taught to think in terms of these sciences, so that when he comes to us in the medical school he does not reply, when asked about the significance, say, of osmotic pressure in the regulation of the distribution of water, "I have heard about osmotic pressure somewhere in college, but I have forgotten all about it."

So with other significant concepts. The significant concepts are memorized for one recitation at some time or other during the course in physics, in chemistry or in biology. They have not been incorporated, nor is there any significant attempt made at the present time to incorporate them, into a system of thinking, what

Dr. Cannan so aptly calls a system of thinking, which leads to a belief in the reasonableness of natural phenomena.

I should like to recall to you that in recent years there has already been made in our colleges of liberal arts a significant step forward precisely in the direction which I have outlined above. In many of our colleges selected groups of students are permitted to follow in their last two or three years an intensive course of study in a limited number of related subjects, in which independent work, reading and informal conferences with instructors take the place of regular lectures, assignments and recitations in a haphazard succession of unrelated subjects. Would it not be worth while for us to consider the possibility of utilizing this already established system of so called "honor courses" for the better training of our premedical students? I submit to you that here, at least, is one approach to this difficult problem, and that under such a system of a coordinated, intensive study the student would at least have more of an opportunity of acquiring that type of mental discipline which we wish for him than he has at present when he is merely acquiring semester hour credits and grades.

Study of Applicants for Admission to the 1935 Freshman Class in Seventy-nine Medical Schools*

(Eighth Study)

FRED C. ZAPFFE
Secretary, Association of American Medical Colleges
Chicago, Illinois

Not until this Association undertook to make this study were any data available as to the number of applicants for admission to medical schools, how many were accepted and rejected, the reasons for rejection, the actual number of applications made each year, the geographic distribution of the applicants or their preparation for the study of medicine, i.e., how much college work did they have. When the study was begun, it was felt that it would yield the answer to all of these questions and also give much other information on topics often discussed in educational gatherings. A question raised frequently was, "Are applicants with a minimum of preparation discriminated against?" This and many other questions are answered by this study.

Each year since 1926, the number of applicants has become larger and likewise the total number of applications made by them. But that is not true of the number of accepted applicants. The desire to study medicine appears to have grown greater year after year. The selection of students by the medical schools is being made with greater care, due, perhaps, to an increase in aids to and methods of selection. In the main, scholarship in the arts college is the chief basis for selection. Personnel tests, various psychological tests, the medical aptitude test and other tests are being used as aids in selection. Every effort is being made to select only those applicants who seem to be sufficiently well prepared to enter on the study of medicine. In spite of all of this care, the mortality in the freshman class has remained fairly constant over a long period of years. True, the study of medicine has become increasingly difficult with the enormous accretions to knowledge in this field; the teaching in the medical schools differs greatly from that in vogue twenty-five years or more ago; it demands greater effort on the part of the student; it is more certain to weed out the unfit than did the older teaching methods. The desire to study medicine is not now the determining factor in securing matriculation. It is the fitness or aptitude for such study on which selection is based.

*This study is one of the activities of the Association of American Medical Colleges. It was initiated in 1926 and was continued for four years. It was not made for the years 1930 and 1931, but was resumed for the year 1932 and has been continued each year since.

Data on Applicants

Table 1 presents a summary of the total number of applicants, number of applications made by them, acceptances and rejections for 1933, 1934 and 1935.

In 1935, 12,740 applicants made 34,427 applications. In 1934, there were 39 more applicants than in 1935, but 1935 shows an increase of approximately 50 per cent over 1926! Applications have increased each year—8 per cent in 1935 over 1934; 10 per cent in 1934 over 1933. The increase for 1935 occurred in large part in the higher brackets of multiple applications.

Table 1. Summary of Totals of Applicants and Applications and Disposition, 1933, 1934 and 1935.

	1933		1934		1935	
Number of applications	29,705		32,321		34,427	
Applications accepted	9,123		8,854		8,300	
Number of applicants	12,128		12,779		12,740	
Single applicants	7,269		7,623		7,231	
Accepted	4,434	(60.9%)	4,433	(58.1%)	3,980	(55.4%)
Rejected	2,835		3,190		3,251	
Multiple applicants	4,859		5,156		5,509	
Accepted	3,109	(63.1%)	2,986	(57.9%)	2,920	(53.0%)
Rejected	1,750		2,170		2,589	
Total applicants accepted	7,543	(62.1%)	7,419	(57.9%)	6,900	(54.1%)
Total applicants rejected	4,585	(37.9%)	5,360	(42.1%)	5,840	(45.9%)

It is noteworthy that the figures for accepted applicants show a considerable downward trend in the three years represented. Undoubtedly, more careful selection is being made with less regard for securing a class of certain size, which was at one time an aim. In 1933, 62.1 per cent of all applicants were accepted; 57.9 per cent in 1934 and 54.1 per cent in 1935. However, these figures do not give the actual number of students who enrolled in the freshman class. Each year from 9 to 11 per cent of applicants accepted fail to matriculate. Some of them seem to give up the idea of studying medicine and enter some other field; others postpone matriculation until they have taken additional work in college, probably having been persuaded to do so by a good advisor or because of a conviction that further work in college is advantageous. Of the 6,900 applicants accepted in 1935, only 6,150 enrolled in medical schools. About 1 to 2 per cent of these will drop out within the first week or two so that it is likely, judging by the experience of preceeding years, that not more than 6,100 will remain until the end of the year.

It is also well to remember in connection with the discussions on "too many physicians," that experience extending over a period of twenty-five years, and more, has shown that from 22 to 25 per cent of every entering class fails to graduate. Thus, it is probable that the graduating class of 1939 will not number more than 4,700. Perhaps, that is still too many physicians, but it does show a decrease in the number of graduates.

There has not been much change in the number of applicants who make only one application and stand by the result. It was virtually the same in 1935 as in 1933, although in 1934, there was an increase of about 5 per cent over 1933. But there has been quite an increase in the number of applicants who make more than one application. In 1934, the increase over 1933 was nearly 10 per cent, with a like increase in 1935 over 1934. It cannot be said that the multiple applicants, as a group, are the least well prepared students because not infrequently a well prepared student will make application to three, four or even five of the better known medical schools. He may be accepted by all of the schools to which he applies, and then makes his choice. He probably only tried to make certain that he would be accepted by one of them, especially if he made application rather late when there was likelihood that no more students could be accepted. On the basis of acceptance, however, it would seem that there is a difference in scholarship between the single and the multiple applicant, although slight.

The urge to study medicine goes on unabated.

Action on Applications

Table 2 presents details for each of the colleges participating in this study. The headings are taken from the application cards: I-1: Accepted, matriculating for first time; I-2: accepted, repeating freshman year; I-3: refused because class full (credentials acceptable); I-4: refused because of personality or poor scholarship; I-5: refused because of unsatisfactory work at another medical school. II. Credentials examined and found inadequate quantitatively: 1. To meet requirements of school; 2. to meet requirements of A.A.M.C. III. Credentials not submitted or examined (no action taken).

Of the seventy-nine colleges included in the study, forty-nine accepted fewer students than in 1934; twenty-six accepted more; three accepted the same number and one did not have a freshman class this year. Six colleges reported more than one thousand applications, the highest figure being 1,235. These numbers represent applications received, each application having been made by an individual applicant—who may or may not have made application to some other school. That some of these applicants

TABLE 2. DATA BY COLLEGES ON TOTAL NUMBER OF APPLICATIONS MADE AND ACTION THEREON (MEN AND WOMEN)

School	I					II		III	Accepted	Rejected	Total	Enrolled in 1935 Class
	1	2	3	4	5	1	2					
Alabama	75		3	388	64	74	1	1	75	531	606	54
Arkansas	95	13	75	8	15	16			108	114	222	92
Med. Evangelists	116		92		2	33		2	116	129	245	109
Stanford	87		138			13		8	87	159	246	59
California	85		8	91	1	31		16	85	147	232	61
So. California	60	2	74	10		67		11	62	162	224	51
Colorado	53	1	5	24	4	1			54	34	88	53
Yale	122		242	62		1		6	122	311	433	58
Howard	40	14	89		2	7	29	39	54	166	220	39
Georgetown	140		201	431	6	8	5	80	140	731	871	101
Geo. Washington	109		5	535	5	14		91	109	650	759	71
Emory	85	4	39	94	1	3	2	27	89	166	255	56
Georgia	40		59		3	18		11	40	91	131	47
Chicago Medical	90	15			1	10		20	105	31	136	61
Loyola	190	1	8	134	19	26		109	191	296	487	142
Chicago	186		517	31		7		23	186	578	764	104
Illinois	129	6	26	65		35		38	135	164	299	169
Northwestern	180	1	369	199	3	13		470	181	1054	1235	124
Indiana	129	1	25	272	1	8	1		130	307	437	118
Iowa	130		4			40		1	130	45	175	119
Kansas	96		53	13			21	109	96	196	292	88
Louisville	131	5	15	458	12	2		6	136	493	629	92
Louisiana	133	9	9	156	35	22	6	43	142	271	413	99
Tulane	233	2	84	59	7	44	5		235	199	434	130
Johns Hopkins	108			170		3			108	173	281	70
Maryland	113	2	82	36	1	6		451	115	576	691	89
Boston	87	4	53	173		2		2	91	230	321	70
Harvard	150		449	107				54	150	610	760	126
Tufts	174		63	129	1	58	16	18	174	285	459	124
Michigan	179		73		1	146			179	220	399	135
Wayne	92	7	5	6		52		5	99	68	167	73
Minnesota	158		21			70		302	158	393	551	103
Mississippi	*14			1		1		16	14	18	32	
Washington	105		148	214	5	53	5	42	105	467	572	84
Missouri	64		9	51	1			2	64	63	127	40
St. Louis	238	3	3	891	22	1	5		241	922	1163	146
Creighton	125	3	11	106	6	10	7	15	128	155	283	80
Nebraska	119	4	30	28		1	3	14	123	76	199	93
Dartmouth	24		3	32	3			87	24	125	149	23
Albany	56		4	294	5	56		25	56	384	440	27
Columbia	107		96	760	1	1			107	858	965	115
Cornell (Ithaca)	26		3	60		4		10	26	77	103	24
Cornell (N. Y.)	106		19	580		2		65	106	666	772	53
Long Island	89	8	101	810	3	30	10	162	97	1116	1213	91
New York Homeo.	119	4	392	230	19	1		22	123	664	787	73
New York Univ.	188		287	391	1	1		2	188	682	870	134
Buffalo	85	5	462	97	19	4	2	329	90	913	1003	72
Rochester	69		276	61	1				69	338	407	48
Syracuse	61		441		5	3		72	61	521	582	45
Duke	99	1	1	531	6	1			100	539	639	70

*Did not enroll.

TABLE 2—Continued

School	I 1	2	3	4	5	II 1	2	III	Accepted	Rejected	Total	Enrolled in 1935 Class
North Carolina	52		10	19	1	21	4	8	52	63	115	38
Wake Forest	26		5	15	4	4		182	26	54	236	25
North Dakota	40	1	9	16		7	4	188	41	224	265	33
Cincinnati	129		213	90	10	98		1	129	412	541	75
Eclectic	58		40	13	6	15		19	58	93	151	46
Ohio	115	6	61	36	10	30		38	121	175	296	102
Western Reserve	72		46	469	6	73		79	72	673	745	72
Oklahoma	72	1	9	23					73	32	105	66
Oregon	96		140	50	1	34		7	96	232	328	64
Hahnemann	252	1	109	2	3	1		398	253	413	766	165
Temple	145	1	639	282	10	9	1	2	146	943	1089	110
Jefferson	172		25	263	6	24		132	172	450	622	137
Pennsylvania	160		861	39		6			160	906	1066	119
Pittsburgh	69		167	4	3	10		7	69	191	260	55
Woman's Medical	36			21	3	12	1	31	36	68	104	57
Med. Coll. So. Car.	39	3	161		9	6	37	116	42	329	371	42
South Dakota	35	3	7	24	9		2	9	38	51	89	25
Meharry	71	5				33			86	33	119	56
Tennessee	167		10	108	9	2			167	129	296	89
Vanderbilt	79	3	8	307	1	10	1	92	82	419	501	50
Baylor	111		37	45	15	4			111	101	212	93
Texas	99	2	87				5		101	92	193	100
Utah	36		29	2	1			1	36	33	69	32
Vermont	50		38	20		9		186	50	253	303	41
Med. Coll. Virgina	105		262	52	7	28		26	105	375	480	79
Virginia	70		33	171	4	2	3	12	70	225	295	66
West Virginia	53		58	31	30	114	5	90	53	328	381	25
Marquette	140	1	170	106	13	9	1	3	141	302	443	97
Wisconsin	110		60	31		1		16	110	108	218	94

made more than one application is shown by the differences between the figures in the "accepted" column and those in the "Enrolled, 1935 class" column. It will also be noted that in some instances more students are reported as having enrolled than were accepted. The reason is that some students were accepted in 1934 but did not enroll until 1935. Then, too, it has been found in the course of this study that colleges do not always report on every applicant or application. Sometimes a student is reported as having been enrolled for whom no card can be found. Again, colleges have reported refusals to accept which are reported on at the end of the year as having been in attendance that academic year. However, these exceptions are not sufficiently large in number to alter any of the conclusions drawn from this study.

ACCEPTANCE ON THE BASIS OF PREPARATION

Table 3 presents the acceptance and rejection of applicants on the basis of length of preparation for the study of medicine. It is an answer to the assertion that there is discrimination in selection against students

who have had less than three years of preparation. Only one medical college requires a degree for admission. However, a number of colleges having a published three year requirement select the class entirely from among the degree holding applicants. Others give preference to degree holders, therefore, accept only a few three year men and women. Attention must be called to a variation in the percentages of acceptance shown in this table and those taken from the enrollment blanks. As stated previously in this report, all accepted students do not matriculate. About 10 per cent do not enroll. Naturally, therefore, the data on preparation for medical study must vary between this table and the enrolment table (not shown here).

TABLE 3. ACCEPTANCES AND REJECTIONS OF APPLICANTS ACCORDING TO LENGTH OF PREPARATION FOR THE STUDY OF MEDICINE.

	Single Applicants accepted	Single Applicants rejected	Multiple Applicants accepted	Multiple Applicants rejected	Totals	% of all applicants	% accepted
Less than 1 year....		3	1		4		
1—2 years.....	2	6		1	9		
2—3 years.....	829	456	139	141	1565	12.3	62.0
3—4 years.....	1352	924	686	742	3704	29.0	55.0
4 or more years.....	262	246	148	223	879	6.9	46.3
A. B. degree.....	846	490	1092	659	3087	24.3	62.4
B. S. degree.....	576	451	830	742	2599	20.4	56.0
Other degrees	42	54	22	49	167	1.3	38.3
Not stated.....	71	621	2	32	726		
Totals 3980		3251	2920	2589	12740		

Table 3 shows that 12.3 per cent of accepted students had from two to three years of preparation in college. The enrolment table shows that 11 per cent fell into this group. Table 3 also shows that 46 per cent of accepted students held a degree—A.B., B.S., Ph.B., Ph.D. (only 6), etc. The enrolment table, on the other hand, shows that 52 per cent of enrolled students had a degree. Each year since 1926, the group of "less than three years of college work" has grown smaller, whereas the degree holding group has grown larger. This would seem to indicate that the students themselves are working out the problem of entrance requirements and that an increase in requirements from two to three years of college work is not a pressing matter at this time. Furthermore, not to increase the requirements at this time will stop claims that a certain group of applicants is being kept from studying medicine; that only the so-called "elect" are permitted to study medicine.

Reference to table 3 definitely refutes any such beliefs. While the less than three years group was represented by only 12.3 per cent of the applicants, 62.0 per cent of these were accepted by medical colleges, a percentage

exceeded only by the A.B. group, of which 62.4 per cent were accepted. The B.S. group came third, with 56.0 per cent accepted; the three to four years group came fourth with 55.0 per cent accepted and the four or more years group with 46.3 per cent accepted. This group had the largest percentage of applicants, 29.0; second, the A.B. group with 24.3 per cent; third, the B.S. group with 20.4 per cent and then the two to three year group with 12.3 per cent. The enrolment table shows that of the last mentioned group only 9 per cent actually had only the minimum preparation—60 hours, or two years of college work. The remaining 2 per cent had from 65 to 79 semester hours. The four or more years group consists of applicants who did not receive a degree and some of whom attended college for as long as nine years. This is a very small group of applicants, 6.9 per cent of all applicants.

TABLE 4. ANALYSIS OF ACTION TAKEN ON ALL APPLICATIONS ON BASIS OF PREPARATION FOR THE STUDY OF MEDICINE

Action Taken	1 year or less	2 to 3 years	3 to 4 years	4 or more years	A.B.	B.S.	Other degrees	Not stated	Totals
I.									
1	1	975	2368	516	2334	1762	70	122	8148
2	5	31	29	11	40	31	1	4	152
3	1	246	1669	445	3121	2672	70	242	8466
4	1	551	2638	918	3547	3100	99	173	11,027
5		26	96	43	143	91	3	40	442
II.									
1	10	208	516	168	216	210	44	189	1561
2		21	30	26	45	35	13	12	182
III.	1	45	747	341	758	735	41	1781	4449
Totals	19	2103	8093	2468	10204	8636	341	2563	34321

SUMMARY

1 year or less of preparation—19. Accepted—6. 2 to 3 years of preparation—2,103. Accepted—1,006 (47.8%). 3 to 4 years of preparation—8,093. Accepted—2,397 (29.6%). 4 or more years preparation—2,468. Accepted—527 (21.3%). A.B. degree—10,204. Accepted—2,374 (23.3%). B. S. degree—8,636. Accepted—1,793 (20.7%). Other degrees—341. Accepted—71 (20.6%). Preparation not stated—2,563. Accepted—126 (.04%).

Figures have been published showing that the number of graduates in medicine who have also held a bachelor's degree is far in excess of the figures shown in table 3. This difference can easily be accounted for when it is recalled that quite a number of students are awarded a degree by their preparatory school on completion of the first year in medical college. In fact, one medical college will not accept any student who will not receive a degree on that plan. Again, other medical colleges, parts of universities, have a combined six or seven years course which increases the number of graduates in medicine who have a bachelor's degree in arts or

science. For the purpose of this study, these figures cannot be considered as they do not have any bearing on the selection of students for the study of medicine on the basis of preparatory study.

Table 4 presents the data of acceptance of applications on the basis of preparation for the study of medicine. This table cannot be correlated with table 3, but it does show some interesting facts. For instance, the 3,087 applicants holding an A.B. degree made 10,204 applications, not quite one third of all applications made. The B.S. men, 2,599 in number, made 8,636 applications; the 1,565 two to three year applicants made only 2,103 applications; the three to four year applicants, numbering 3,704, made 8,093 applications. The two to three year applicants, then, made fewer multiple applications than did the applicants in the other groups.

TABLE 5. DATA ON WOMEN APPLICANTS IN 1933, 1934 AND 1935.

	1933		1934		1935	
Total applications made by women	833		1034		1443	
Applications accepted	410	(49.4%)	464	(44.8%)	414	(28.6%)
Total women applicants	507		636		689	
Single applicants	355		458		439	
Single applicants accepted	200	(56.3%)	262	(51.0%)	230	(54.6%)
Multiple applicants	152		178		250	
Multiple applicants accepted	116	(76.3%)	122	(68.5%)	149	(59.6%)

The figures in the "preparation not stated" group are quite large and, if exact information had been given for this group, percentages might have been changed considerably for all groups. But the check which the enrolment table gives shows that the variations in results would have been distributed fairly evenly and without throwing doubt on any result here stated. Most, if not all, of the applicants in the "not stated" group had made application after classes were filled; therefore, the applications were not considered by the college and it was not regarded as being essential to fill out the question on the card which requests "premedical preparation."

WOMEN APPLICANTS

The data on women applicants show some rather significant facts. (Table 5). Each year the number of women applicants has increased. For the year 1935, this increase amounted to 9 per cent over 1934 and nearly 35 per cent over 1933. The increase in applications in 1935 over 1933 was approximately 75 per cent. The reason for this increase is not clear. Perhaps, certain fields in medicine are attracting women. No study has ever been made to show the final distribution of women graduates in medicine. Such a study might yield the answer to the question why more women want to study medicine. True, years ago, only a few medical schools accepted women students. That is not true today. All but nine

of the schools included in this study accepted women. Only three of the nine did not report any applications made by women. These three schools have never accepted women. Four of the nine schools are two year schools, schools which offer only the first two years of the medical course. There is now only one school accepting only women. That school in 1935 accepted only 36 applicants, a little less than 10 per cent of the total number of women applicants (379). Therefore, the co-educational schools appear to be in favor with women. They accepted nearly 90 per cent of the women applicants.

Table 6 gives the data on acceptances of women by schools in 1934 and in 1935. It also shows how many women applied. The percentage of women accepted is a little larger than that of men accepted. That fact, probably does not have special significance as the difference is too small to permit of drawing a conclusion.

Multiple Applicants

Table 7 needs no explanation. The largest number of applications made by one applicant was 36. In 1934, it was 37; in 1933, it was 41. Comparison of this table with the companion table of 1934 shows that in nearly every bracket there was an increase in the number of multiple applicants.

The multiple applicants present quite a problem for admission officers. A great deal of time necessarily must be spent in evaluating credentials of applicants who do not have any chance of being accepted. It should be possible to lighten this load. It could be done if every applicant were asked to pay an evaluating fee, or an application fee. A few applicants might even be willing to pay such a fee, but undoubtedly a large number would hesitate before making ten, twenty, thirty or more applications if they had to make a payment with each application. It is common practice in many institutions to charge such a fee, usually $5. Would any one make 36 applications if he had to remit $5 with each application? Hardly! Incidentally, this income could be used to good advantage by every medical school in one way or another. Even a smaller fee would help to defray the expense of evaluating credentials.

Geographic Distribution of Applicants

Table 10 presents the geographic distribution of all applicants. Every state of the United States had one or more applicants. Hawaii, Puerto Rico, Alaska, Panama, Haiti and twenty foreign countries are also represented.

Again New York heads the list with approximately 21 per cent of all applicants. Pennsylvania ranks second. New York had 150 per cent more

TABLE 6. APPLICATIONS MADE BY WOMEN APPLICANTS AND NUMBER ACCEPTED (PER SCHOOL). RATIO 1934—1935.

School	1934		1935	
	No. applying	No. accepted	No. applying	No. accepted
Alabama	8	2	11	3
Arkansas	5	5	8	6
Medical Evangelists	16	9	18	9
Stanford	7	3	20	1
California	17	2	35	16
Southern California	12	2	22	0
Colorado	9	8	6	4
Yale	28	8	22	10
George Washington	21	11	31	4
Howard	9	3	5	2
Emory	0	0	1	0
Georgia	4	1	3	1
Loyola	14	8	20	6
Northwestern	43	5	58	4
Chicago	23	16	46	12
Illinois	33	10	21	8
Chicago Medical	4	3	4	4
Indiana	17	4	20	10
Iowa	6	4	9	7
Kansas	14	10	9	5
Louisville	9	2	19	4
Tulane	10	4	14	3
Louisiana	15	9	13	6
Johns Hopkins	24	9	28	10
Maryland	14	10	20	2
Boston	13	9	25	12
Tufts	17	9	18	8
Wayne	9	5	9	2
Michigan	18	14	28	15
Minnesota	11	8	15	8
Mississippi	4	3	0	0
Missouri	4	2	1	1
Washington	10	6	17	5
Creighton	4	3	6	3
Nebraska	1	0	4	4
Dartmouth	2	0	0	0
Albany	11	2	13	2
Columbia	45	10	78	10
Cornell (Ithaca)	6	3	10	3
Cornell (New York)	56	14	67	10
Long Island	28	10	56	7
New York Homeopathic	8	3	31	8
New York University	32	13	50	16
Syracuse	3	2	21	2
Buffalo	15	6	41	5
Rochester	11	2	19	3

TABLE 6—Continued

School	1934		1935	
	No. applying	No. accepted	No. applying	No. accepted
Duke	19	6	23	2
North Carolina	7	5	6	0
Wake Forest	0	0	7	2
North Dakota	5	1	5	0
Ohio	12	5	16	9
Cincinnati	8	7	22	9
Western Reserve	14	8	26	4
Eclectic	2	2	3	2
Oklahoma	3	3	2	2
Oregon	11	6	18	11
Hahnemann	2	0	2	0
Pennsylvania	34	5	45	6
Temple	24	10	47	10
Pittsburgh	12	4	14	4
Woman's Medical	89	60	104	36
Med. Coll. So. Carolina	11	3	19	2
South Dakota	0	0	4	0
Meharry	6	5	4	2
Tennessee	7	5	5	5
Vanderbilt	13	4	12	2
Baylor	9	6	8	6
Texas	13	8	12	10
Utah	3	3	2	2
Vermont	8	4	14	5
Med. College Virginia	6	6	19	11
Virginia	5	3	8	4
West Virginia	16	4	11	1
Marquette	5	4	12	2
Wisconsin	10	5	12	4

applicants than Pennsylvania. These two states had more than one third of all applicants in 1935.

The seven states having more than 500 applicants each had 53.7 per cent of all applicants. The next group of states, again seven in number, having from 200 to 400 applicants each, had 15.7 per cent of all applicants. These fourteen states, then, were represented by 69.4 per cent of all applicants. The order of the first seven states is virtually the same as in 1934; that of the first five states is exactly the same.

On the basis of population of these states, New York, with a population of 12,500,000 (1930 U. S. census), had 2,636 applicants. Pennsylvania, with 9,500,000 population, had 1,079 applicants. On this basis, New York had at least twice as many applicants as it should have had. Of course, it must be remembered that the state of New York probably has many more colleges and universities in which students prepare for the

TABLE 7. DETAILS ON 5590 MULTIPLE APPLICANTS AS TO NUMBER OF APPLICATIONS MADE, ACCEPTANCES AND REJECTIONS.

1934 made 2 applications=3868
832 had no acceptances.
1102 had 1409 acceptances.
1 acceptance—795
2 acceptances—307

1004 made 3 applications=3012
411 had no acceptances.
593 had 869 acceptances.
1 acceptance—369
2 acceptances—172
3 acceptances— 52

637 made 4 applications=2548
276 had no acceptances.
361 had 567 acceptances.
1 acceptance—211
2 acceptances—110
3 acceptances— 24
4 acceptances— 16

460 made 5 applications=2300
221 had no acceptances.
239 had 392 acceptances.
1 acceptance—144
2 acceptances— 57
3 acceptances— 20
4 acceptances— 16
5 acceptances— 2

305 made 6 applications=1830
161 had no acceptances.
144 had 249 acceptances.
1 acceptance—81
2 acceptances—33
3 acceptances—21
4 acceptances— 7
5 acceptances— 1
6 acceptances— 1

214 made 7 applications=1498
111 had no acceptances.
103 had 187 acceptances.
1 acceptance—52
2 acceptances—29
3 acceptances—14
4 acceptances— 5
5 acceptances— 3

180 made 8 applications=1440
100 had no acceptances.
80 had 130 acceptances.
1 acceptance—44
2 acceptances—22
3 acceptances— 7
4 acceptances— 5
5 acceptances— 2

150 made 9 applications=1350
93 had no acceptances.
57 had 98 acceptances.
1 acceptance—30
2 acceptances—19
3 acceptances— 3
4 acceptances— 4
5 acceptances— 1

99 made 10 applications=990
62 had no acceptances.
37 had 54 acceptances.
1 acceptance—23
2 acceptances—11
3 acceptances— 3

86 made 11 applications=946
52 had no acceptances.
34 had 50 acceptances.
1 acceptance—26
2 acceptances— 2
3 acceptances— 5
5 acceptances— 1

59 made 12 applications=708
39 had no acceptances.
20 had 31 acceptances.
1 acceptance—14
2 acceptances— 2
3 acceptances— 3
4 acceptances— 1

66 made 13 applications=858
35 had no acceptances.
31 had 45 acceptances.
1 acceptance—19
2 acceptances—10
3 acceptances— 2

TABLE 7—Continued

53 made 14 applications=742
38 had no acceptances.
15 had 20 acceptances.
1 acceptance—10
2 acceptances— 5

48 made 15 applications=720
26 had no acceptances.
22 had 33 acceptances.
1 acceptance—14
2 acceptances— 6
3 acceptances— 1
4 acceptances— 1

35 made 16 applications=560
23 had no acceptances.
12 had 15 acceptances.
1 acceptance—10
2 acceptances— 1
3 acceptances— 1

41 made 17 applications=697
26 had no acceptances.
15 had 24 acceptances.
1 acceptance—10
2 acceptances— 2
3 acceptances— 2
4 acceptances— 1

14 made 18 applications=252
8 had no acceptances.
6 had 8 acceptances.
1 acceptance—5
3 acceptances—1

18 made 19 applications=342
12 had no acceptances.
6 had 12 acceptances.
1 acceptance—3
2 acceptances—2
5 acceptances—1

23 made 20 applications=460
14 had no acceptances.
9 had 12 acceptances.
1 acceptance—8
4 acceptances—1

16 made 21 applications=336
10 had no acceptances.
6 had 10 acceptances.
1 acceptance—3
2 acceptances—2
3 acceptances—1

12 made 22 applications=264
6 had no acceptances.
6 had 9 acceptances.
1 acceptance—5
4 acceptances—1

10 made 23 applications=230
7 made no acceptances.
3 had 5 acceptances.
1 acceptance—2
3 acceptances—1

11 made 24 applications=264
3 had no acceptances.
8 had 10 acceptances.
1 acceptance—7
3 acceptances—1

4 made 25 applications=100
4 had no acceptances.

3 made 26 applications=78
3 had no acceptances.

8 made 27 applications=216
5 had no acceptances.
3 had 4 acceptances.
1 acceptance—2
2 acceptances—1

2 made 28 applications=56
1 had no acceptance.
1 acceptance—1

3 made 29 applications=87
3 had no acceptances.

2 made 30 applications=60
1 acceptance—2

7 made 31 applications=217
4 had no acceptances.
1 acceptance—3

2 made 32 applications=64
1 had no acceptances.
1 acceptance—1

1 made 33 applications=33
No acceptances.

1 made 34 applications=34
No acceptances.

1 made 36 applications=36
1 acceptance.

TABLE 8. GEOGRAPHIC DISTRIBUTION OF 12,740 APPLICANTS*

	Single applicants	Multiple applicants	Total
New York	977	1659	2636
Pennsylvania	517	562	1079
Illinois	543	248	791
Ohio	340	314	654
California	347	286	633
New Jersey	192	341	533
Massachusetts	180	335	515
Texas	262	118	380
Michigan	251	69	320
Wisconsin	247	58	305
Indiana	249	54	303
Minnesota	205	53	258
Missouri	143	89	232
Iowa	174	32	206
North Carolina	126	71	197
Georgia	133	62	195
Nebraska	151	38	189
Louisiana	165	22	187
Connecticut	58	114	172
District of Columbia	124	43	167
Kansas	116	51	167
South Carolina	125	40	165
Kentucky	124	39	163
West Virginia	78	84	162
Virginia	115	44	159
Tennessee	134	24	158
Oklahoma	110	43	153
Maryland	108	44	152
Alabama	84	36	120
Mississippi	83	36	119
Arkansas	106	8	114
Washington	55	55	110
Florida	52	42	94
Colorado	68	21	89
Oregon	71	16	87
North Dakota	51	26	77
Rhode Island	20	56	76
Utah	37	34	71
Maine	29	36	65
Vermont	51	7	58
New Hampshire	26	31	57
South Dakota	44	8	52
Puerto Rico	24	23	47
Montana	22	19	41
Hawaii	8	27	35
Idaho	13	22	35
Canada	22	7	29
Delaware	9	13	22

*Every state is represented and also Hawaii, Puerto Rico, Alaska, Panama, Haiti and 20 foreign countries.

TABLE 8—Continued

	Single applicants	Multiple applicants	Total
Arizona	10	9	19
New Mexico	5	9	14
Nevada	2	7	9
China	5	3	8
Panama	5	2	7
Cuba	5	2	7
Wyoming	5	2	7
Mexico	3	2	5
Phillipine Islands	4		4
India	3		3
England	2	1	3
Persia		3	3
Korea	2	1	3
Japan	1	1	2
Haiti	1	1	2
Peru	1	1	2
Brazil	2		2
British West Indies	1	1	2
Sweden	1		1
South Africa	1		1
France		1	1
Spain	1		1
Dominican Republic		1	1
Alaska		1	1
Germany		1	1
Argentina		1	1
Greece		1	1

study of medicine than Pennsylvania or any other state has. Therefore, it would have a larger number of applicants. It might be argued that in most of the states the number of applicants is entirely too small for the population of the state, but, after all, it is a fact that graduates do not always return to the state from which they originated or even the state of their birth. Hence, it is impossible to lay down any dictum as to how many applicants should come from a state solely on the basis of population. The study of student accomplishment has shown that about 10 per cent of the 6,500 freshman students came from six or seven arts colleges. Of the 600 arts colleges sending students to medical school each year, only eighty send more than fifteen students each. Many colleges send only one, two or three students. The location of the college and the state of residence of the student are not always the same; therefore, in the main, geographic distribution of applicants is rather a futile topic for an argument. Factors other than residence might have a bearing on the problem.

What becomes of the applicants who were not accepted? This question is asked often. A check up made of some applicants has shown that

they apply year after year until accepted or until they are convinced that they will not be accepted. Then they go to Great Britain or some other foreign country. Great Britain has many of these applicants, especially in the so-called extramural schools. Other applicants appear to have given up the idea of studying medicine. Their names do not appear again. A few finally are accepted when there is a vacancy in the class, thus increasing, although not in a high degree, the number of accepted applicants. Although exact figures are not available, it may be said that the majority of rejected applicants do not apply again.

It is impossible to draw any conclusions from these figures, nor to make any statement which would alter any totals. Raising the requirements for admission from two to three years of college work would eliminate 11 per cent, but shortly the original figures would be restored when these students are able to comply with the increased requirement. Medical schools could, of course, reduce the number of medical students by fewer acceptances, as was done, in some instances this year, but one must be mindful of the charge of attempting to create an "aristocracy in medicine." Every acceptable student deserves careful consideration, and the number of years of attendance in an arts college does not always determine acceptability. The two year students make a very good record in college, on the whole, because they represent a carefully selected group. Even if an evaluation fee were charged it would not insure a better result in selection than is now the case, although it undoubtedly would deter some poorly prepared students from making so many applications. And yet, one man made seventy applications in three years and then secured admission in a foreign medical school! Time and experience may give the answer.

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American Council On Education

A regional meeting was held by the Council in Chicago recently. The secretaries of constituent members of the Council whose headquarters are in the Chicago area attended this conference on the call of the president, Dr. George F. Zook.

The meeting was called for the purpose of discussing problems of mutual interest in which the Council might give service.

A topic which gave rise to considerable discussion was that of examinations for licensure to practice medicine. There is room and need for changing the character of these examinations to bring them in line with modern procedures in education and examinations in general. It was deemed possible that if the Council would interest itself in this matter a change might be effected. Dr. Zook volunteeered to bring it to the attention of the Council.

Another topic of discussion was this: Should approval be extended to a university by any of the accepted regional evaluating agencies if any of its schools or component parts is not approved by some other agency? If the school of medicine is not approved, should the university as a whole be approved? The same question can be raised in connection with any other schools in the university—law, dentistry, nursing education, etc.

This meeting marks an epoch in education which is certain to bring about many changes which those in the fields covered by the conference feel are highly desirable. And it enlists a powerful aid —the American Council on Education which, until now, has not been active in these fields to an appreciable degree. Therefore, the future is full of promise.

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Elias P. Lyon

The many friends of Dr. Lyon will regret deeply his retirement from the deanship of the University of Minnesota Medical School, a position he has held since 1913 with great honor to himself and to the university. The rule of retirement on account of having reached the age limit set by the university authorities removes from the field of medical education a notable figure. Dr. Lyons has always been very active in this field and has made many worth while suggestions for the advancement of not only medical education but general education as well. He held many important positions in the Association of American Medical Colleges, including membership on the Executive Council for many years and was its president in 1913-1914. Being free from administrative and teaching responsibilities Dr. Lyons may give much of his time and energy, of which he has a considerable stock, in spite of his retirement on account of age, to the advancement of medical education. He is a man of ideas as well as of action. May the years of his life be many and filled with joy and pleasure which he so richly deserves.

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Augustus S. Downing

Augustus S. Downing died suddenly in his home in Albany, N. Y., on February 5th at the age of 79. For many years of his very active life, Dr Downing was

interested in education. For a long time, he was assistant commissioner of education and director of professional education of the State of New York. He was in large part responsible for the passage of the present medical practice act. He was keenly interested in medical education and was a regular attendant at the annual meetings of this Association and took an active part in the discussion of papers read. As a result of his insistence, the allowing of conditions in admitting applicants to medical colleges, this practice was abandoned. His advice was always constructive and helpful. He retired from active work in 1927.

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Hospital Statistics

The Journal of the American Medical Association, March 7, 1936, presents the annual statistics on hospitals compiled by the Council on Medical Education and Hospitals. Of the 7,043 hospitals, sanatoriums and related institutions investigated by the Council, 6,479 have been approved. Two hundred and thirty-three of these institutions are situated in the territories and possessions of the United States. Five hundred and sixty-four hospitals were not approved. Seven hundred and eight (708) hospitals are approved for intern training. These hospitals furnish about 6,500 approved internships, more than sufficient to give opportunity for such training to the graduates of approved medical schools. In how many of these hospitals the education of the intern is continued on an acceptable basis is not stated. Doubtless the number is very small. However, it is likely that it will become larger as a result of efforts now being made by various organizations, including the hospital associations, to insist on such a service as a criterion for recommendation for supplying desirable interns. If this so-called fifth year is to be an educational year, there must be organization of hospital staffs on a teaching basis and the work must be under the supervision of accepted authorities in this field. It is not only an opportunity for the intern to learn but for the hospital to give the best service to its patients.

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This Issue

This issue of the JOURNAL presents the papers read at the Toronto meeting by three members of faculties of arts colleges and correlating papers read by three representatives of the faculties of medical schools.

To bring these papers before the faculties of the arts colleges copies of this issue have been sent to the heads of the departments of biology, chemistry and physics in the arts colleges which usually send some of their students to medical schools and which are, therefore, specially interested in the preparation of men and women for the study of medicine. It is hoped that some worth while results will accrue from this plan to the end that there will be better understanding of what course in education will be most profitable for the student who intends to be a physician and to clarify the situation as to what medical schools desire when they lay down requirements for admission to their courses. These requirements are based on "education" rather than on "training," a word much misused in this connection. Furthermore, they prescribe minima not maxima.

It is hoped that the response from arts college faculties and administrators will he helpful in effecting changes which will bring to the medical schools students better prepared for the study of medicine than has often been the case and thus lower the mortality of the freshman class —15.3 per cent in 1934-1935.

College News

Washington University School of Medicine

Mu chapter of the Phi Beta Pi medical fraternity has established a lectureship in honor of Dr. Leo Loeb, professor of pathology in the school. Medical scientists of distinction will be invited each year to address the students and faculty of the school, members of the university and the medical public.

Dr. Walter B. Cannon, Higginson professor of physiology in Harvard Medical School, delivered the first lecture March 2. His subject was "Some Adventures in Discovery."

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Harvard Medical School

Dr. Cyrus H. Fiske, associate professor of biochemistry, has been appointed professor. Dr. Henry A. Christian, Hersey professor of the theory and practice of physics, was recently presented with a volume of medical papers dedicated to him by his former students, colleagues and house officers as a token of affection on his sixtieth birthday.

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University of Alabama School of Medicine

Dr. John H. Musser, professor of medicine in Tulane University of Louisiana, was guest speaker on the occasion of the observance of the birthday of General Gorgas by the Gorgas Medical Society. His subject was "The Life and Work of Sir William Osler; with Some Personal Reminiscences."

Dr. Roy R. Kracke, professor of pathology in Emory University School of Medicine, gave a lecture on "The Dangers of Self Medication" under the auspices of Phi Beta Pi medical fraternity.

University of Kansas School of Medicine

In 1918, Dr. J. L. Porter, Paola, Kansas, bequeathed a sum of money for the stimulation of scholarship and research in the Medical School. A portion of the income from this fund has been used to provide a scholarship for a worthy student. The remainder of the income is to be used to defray the expenses of an annual lecturer in medicine.

The sixth course of lectures under this lectureship will be given by Dr. Jennings C. Litzenberg, professor of obstetrics and gynecology in the University of Minnesota Medical School, on March 17 and 18. His subjects will be: 1. The Pathology of Ectopic Pregnancy; 2. The Physician Who Became God; 3. Missed Abortion. The first and third lectures will be delivered in Kansas City, Kansas; the second in Lawrence, Kansas.

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Dalhousie University Faculty of Medicine

Dr. C. B. Weld, of the department of physiology in the University of Toronto, has been appointed professor of physiology, to succeed Dr. E. W. H. Cruickshank who resigned in 1935.

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McGill University Faculty of Medicine

The medical course has been reorganized. The new plan provides: (1) The minimum period of professional training required as a qualification for the independent practice of medicine shall be five years, including (a) four years of medical study leading to the degree of Md., C.M., and (b) one year of internship in an approved hospital, or one year of further medical study in the Fac-

ulty of Medicine of McGill University or of another medical school approved by it. (2) A certificate that his medical education is completed and that he is eligible to sit for the examination of a licensing board shall not be issued to any graduate until the University is in possession of satisfactory evidence that he has completed the full requirements.

The present course spreads over five academic years of seven months and one half each. The new course will cover four years of nine months each, the intern year being an additional year.

The minimum requirement for entrance to the four year course will remain as it is at present, namely, the satisfactory completion of three years of study in a College or Faculty of Arts and Science, including both lecture and laboratory courses in physics, biology and chemistry, inorganic and organic. A four year course leading to the A.B. or B.S. degree is considered the most desirable preparation for the study of medicine. Preference will be given, therefore, to applicants who have had a full academic course in which the humanistic studies have not been sacrificed to a narrow scientific specialization.

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University of Pennsylvania School of Medicine

A bequest amounting to about $116,000, made by the late Dr. Delno A. Kercher, has been received. It is to be used for a loan fund for students after their first year, graduate students and research workers.

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Cornell University Medical College

Dr. Oskar A. Diethelm, associate psychiatrist at Johns Hopkins Hospital, has been appointed professor of psychiatry to succeed Dr. George S. Amdsen who retired in 1935. Dr. Diethelm is a graduate in medicine of the University of Zurich.

Georgetown University School of Medicine

Dr. Charles Owen McCormick, Assistant Professor of Obstetrics at Indiana University School of Medicine, was a guest lecturer in obstetrics at Georgetown University School of Medicine on February 28, 1936. His lecture, well illustrated with motion pictures, was on the subject "Analgesia in Labor" showing their modified Gwathmey method.

There has been installed this year in the curriculum of the senior year a course in Medical Social Economics. The lectures on the various aspects of this subject are given by authorities in their respective fields. Those now giving lectures are Doctors Arthur C. Christie, Ross Garrett, Oscar B. Hunter, Henry C. Macatee, George C. Ruhland, J. Russell Verbrycke, Jr. and Wallace M. Yater.

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Temple University School of Medicine

The departments of neurology and neurosurgery have been combined, with Dr. Temple Fay as head of the department and Dr. James William McConnell, of the Graduate School of Medicine of the University of Pennsylvania, professor of neurology. Drs. Clemens, Sloane and Silverstein have been retained on the staff and Dr. Samuel B. Hadden and Dr. James J. Waygood have been appointed associates in neurology.

The department of pathology has been completely reorganized under the direction of Dr. Lawrence Weld Smith, formerly of Cornell University Medical College. Dr. H. C. Lennon and Dr. Ernest E. Aegerter have been appointed instructors in this department.

APPOINTMENTS: Drs. Robert H. Hamilton, assistant professor of physiological chemistry; Francis William Glenn, clinical assistant in orthopedics; C. Howard McDevitt, Jr., clinical assistant in surgery; Harvey A. Price, clinical assistant

in proctology; Hubert A. Royster, Jr., clinical assistant in pediatrics; Hugh Hayford, clinical assistant in obstetrics; Edwin J. Fellows, instructor in bacteriology and in pharmacology; Michael Scott, clinical assistant in neurosurgery; Nathaniel Hurwitz, clinical assistant in otology.

PROMOTIONS: Edward Weiss, from clinical professor to professor of clinical medicine; J. P. Guequierre, from associate to assistant professor of dermatology and syphiolology; Harry E. Bacon, from lecturer to associate in proctology; Chas. Q. DeLuca and A. Neil Lemon, from demonstrator to associate in laryngology and rhinology; Reuben Friedman, from demonstrator to lecturer on dermatology and syphilology; Saumel Ringold, from instructor to demonstrator in laryngology and rhinology; C. Kenneth Miller, from instructor to demonstrator and Franklin D. Benedict, from clinical assistant to instructor in proctology.

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Medical College of Virginia

Dr. Edward C. Rosenow, head of the Division of Experimental Bacteriology, Mayo Foundation, will give the McGuire lectures at the Medical College of Virginia on the nights of April 6 and April 7. His subjects will be "Focal Infection and Elective Localization and Streptococci in Relation to Diseases of the Nervous System." April 7 a symposium on focal infections will be conducted by the college faculty.

Dr. Grant Van Huysen has joined the staff of the college as associate in anatomy.

The college recently received an anonymous gift of 250 milligrams of radium for its hospital division.

Dr. L. R. Broster, chief surgeon of the Charing Cross Hospital and prominent endocrinologist of England was a recent college visitor, lecturing to the students while here.

March 16 the Saint Philip school of nursing, a separately organized unit of the college, will inaugurate a new course in public health nursing, covering one year's work, for Negro graduate nurses. This course has been approved by the United States Public Health Service for the training of public health nurses from eighteen cooperating states under the Social Security Act.

The General Education Board has for the sixth consecutive year made a grant of $1,200 to the college for a two weeks' postgraduate clinic for Negro physicians to be given in June.

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University of Virginia Department of Medicine

At the meeting of the University of Virginia Medical Society held February 17, Dr. Alfred Chanutin spoke on the subject of "Some Clinical Aspects of Lipid Metabolism."

March 2, Dr. Arnold Rice Rich, associate professor of pathology in Johns Hopkins University, gave the mid-year Alpha Omega Alpha lecture, speaking on the subject of "Immunity in Tuberculosis."

For the third consecutive year the Edward N. Gibbs Prize of the New York Academy of Medicine was awarded to Dr. Alfred Chanutin, professor of biochemistry. The stipend of the award is to be applied to a continuation of research on kidney diseases.

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Wayne University School of Medicine

Dr. Raymond B. Allen, associate dean of graduate studies, Columbia University College of Physicians and Surgeons, New York, has been named dean. He succeeds Dr. Walter H. MacCraken, who resigned last year. Dr. William J. Stapleton, Jr., who has been acting dean of the school, will become associate dean when Dr. Allen takes over his duties, May 18.

University of Illinois College of Medicine

A new department of neurology and neurological surgery has been created. Dr. Eric Oldberg has been appointed professor and head of this new department. Dr. Oldberg has been acting head of surgery since the death of Dr. Carl A. Hedblom.

Dr. Warren H. Cole of the department of surgery of Washington Universtiy, St. Louis, has been appointed professor and head of the department of surgery to succeed Dr. Hedblom.

Both of the above appointments will begin September 1, 1936.

The Gehrmann Lectures for 1935 were delivered by Dr. Victor G. Heiser, New York City, formerly director of Far East of the International Health Board of the Rockefeller Foundation on April 29 and 30, and May 1. His subjects were: 1. "Coordination of Disease Control Throughout the World by the League of Nations;" 2. "International Research in Leprosy;" 3. "Dietary Opportunities in Preventive Surgery."

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Duke University School of Medicine

February 24th and 25th, Dr. Edward R. Baldwin, Director of the Edward L. Trudeau Foundation for Research and Teaching in Tuberculosis, lectured to the faculty and students on The History of Tuberculosis Research in America.

George T. Harrell, Jr., and Joseph B. Stevens, members of the senior class, recently were elected to membership in the Alpha Omega Alpha honorary medical fraternity.

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Emory University School of Medicine

Dr. James R. McCord, professor of gynecology and obstetrics, on a part time basis, has been named to a full time position. For several years he has been conducting extension courses in obstetrics throughout the United States in his capacity as senior medical officer and special representative of the Children's Bureau of the U. S. Department of Labor.

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Dartmouth Medical School

Dr. Ralph E. Miller, assistant professor of pathology, has been promoted to be associate professor and appointed dean of the school.

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Washington University School of Medicine

The W. K. Kellogg Foundation financed a two weeks' graduate course in medicine, beginning April 13, for physicians in seven counties and Battle Creek, which areas are included in the community health project sponsored by the foundation. The course was under the direction of Dr. McKim Marriott, dean and professor of pediatrics, at the medical school, and was adapted to the needs of the general practitioner.

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University of Rochester School of Medicine

Dr. George W. Corner, professor of anatomy, has been named Thomas Vicary lecturer for 1936 of the Royal College of Surgeons. The lecture will be given in December on a subject in the history of anatomy or surgery. Dr. Corner will also give a series of lectures on physiology of the ovarian hormones under the auspices of the University of London and Guy's Hospital Medical School.

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University of Toronto Faculty of Medicine

The tenth annual lecture of the Donald C. Balfour Lectureship in Surgery was delivered April 6 by Dr. Melvin S. Henderson, professor of orthopedic surgery, Mayo Foundation Graduate School, University of Minnesota. His subject was "Orthopedic Surgery: An Historical Review."

University of Pennsylvania School of Medicine

Dr. Eugene Markley Landis, assistant professor of medicine, received the Phillips Memorial Medal of the American College of Physicians at the annual session of the college in Detroit, March 4, in recognition of work in the field of capillary physiology and disturbances of the peripheral circulation.

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University of Pittsburgh School of Medicine

Davenport Hooker, Ph.D., professor and head of the department of anatomy, delivered the third Harry Burr Ferris lecture in anatomy at Yale University, New Haven, in the Sterling Hall of Medicine, February 19, on "Early Fetal Movements in Mammals."

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Harvard Medical School

Dr. Hans Zinsser, professor of bacteriology and immunology, has been appointed Charles Wilder professor of bacteriology and immunology. This professorship has only recently been assigned to the department of bacteriology.

Albany Medical College

The new laboratory building of the college has been named "The Theobald Smith Memorial Laboratory." Dr. Smith was a native of Albany, attended the city schools and the Albany High School and received the degree of doctor of medicine from the Albany Medical College in 1883. His academic work was done in Cornell University.

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Syracuse University College of Medicine

Dean H. G. Weiskotten was recently appointed a member of the New York State Health Council to succeed Dr. Frederick F. Russell, resigned.

It is reported that work on a new medical college building is progressing rapidly and that occupancy is assured for the opening of the next academic session.

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Howard University School of Medicine

A grant of $100,000 has been received from the Rockefeller Foundation, to be used over a period of five years toward the developments of the departments of medicine and surgery.

General News

Herzstein Lectures for 1936

The Morris Herzstein Course of medical lectures for 1936 was given by Dr. John Gerald FitzGerald on March second, third and fourth. Dr. FitzGerald is professor of hygiene and preventive medicine, Director of the School of Hygiene and of the Connaught Laboratories, and Dean of the Faculty of Medicine of the University of Toronto.

The titles of the lectures were:

(1) "Precept and Practice of Preventive Medicine," (2) "The Practice of Preventive Medicine in the Prevention and Control of Diphtheria," (3) "The Practice of Preventive Medicine in the Prevention of Localized Staphylococcic Infections."

The Morris Herzstein Lectures were established in 1929 by the late Dr. Morris Herzstein of San Francisco to be given under the direction of the Medical Schools of Stanford University and the University of California.

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American Association on Mental Deficiency

This association, composed of about 500 educators, psychologists, sociologists and psychiatrists will hold its sixtieth annual meeting at the Hotel Jefferson, St. Louis, Mo., May 1, 2, 3 and 4. The Friday sessions will be devoted to general and sociological aspects of mental deficiency; the Saturday sessions to psychological and educational topics with special stress on educational disabilities. The Monday sessions will be given over to research activities, medical aspects and administrative problems in mental deficiency.

Some of the speakers are: Popenoe, on "Sterilization;" Goddard, on "Social Security;" Hincks, on "A National Program;" Kirkbride, on "Public Welfare;" Hackbusch, on "Social Service;" Vanuxem, on "Education;" Berry, on "Teaching Techniques;" Humphreys, on "Research Problems," and many others. Everyone interested in the mentally defective or retarded child is cordially invited to attend these sessions. The complete program may be obtained from the secretary, Dr. Groves B. Smith, Godfrey, Illinois.

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Federation of State Medical Boards

At the annual meeting of the Federation held in Chicago, February 17th, Dr. Jesse W. Bowers, of Fort Wayne, Indiana, president of the State Board of Medical Registration, was elected president-elect; Dr. Walter L. Bierring, Des Moines, Iowa, was re-elected secretary-treasurer. Dr. John N. Baker, Montgomery, Alabama, secretary of the State Board of Health, assumed the presidency for the ensuing year. The retiring president is Dr. I. S. Metzger, Pittsburgh, president of the Pennsylvania State Board of Registration in Medicine. The Federation was organized in 1912.

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Amory Fund

The late Francis Amory, of Beverly, Mass., bequeathed $10,000 to the American Academy of Arts and Sciences to be awarded, all or in part, as a septennial prize in 1940, and every seventh year thereafter, for the most valuable contribution to the knowledge of diseases of the human sexual generative organs.

Address inquiries to the Amory Fund Committee, American Academy of Arts and Sciences, 28 Newberry Street, Boston, Mass.